FAA-E-2689a
NOTICE-3
December 9, 1992

U.S. Department of Transportation

Federal Aviation Administration

Specification

DUAL MODE

HIGH INTENSITY APPROACH LIGHTING SYSTEM

(ALSF-2/SSALR)

Specification Change Notice (SCN)

1. Originator Name and Address	2. ☐ Proposed ☐ Approved	3. Code Ident	4. Spec No. FAA-E-2689a
Clesson McDonald, ANN-140		5. Code Ident	6. SCN NO. 3

7. System Designation	8. Related ECP/NCP No.	9. Contract No.	10. Procuring Activity

11. Configuration Item Nomenclature	12. Effectivity
	December 9, 1992

This notice informs recipients that the specification identified by the number (and revision letter) Shown in block 4 has been changed. The pages changed by this SCN (being those furnished herewith) carry the same date as this SCN. The page numbers and dates listed below in the summary of changed pages, combined with nonlisted pages of the original issue of the revision shown in block 4, constitute the current version of this specification.

13. SCN No.	14. Pages Changed (Indicate Deletions)	S*	A*	15. Date
3	3 (No Change)			03/12/91
3	4	x		03/12/91
3	4a		x	12/09/92
3	4b		x	12/09/92
3	6a	x		03/12/91
3	6b	x		03/12/91
3	6c		x	12/09/92
3	6d		x	12/09/92
3	7	x		03/12/91
3	7a		x	12/09/92
3	7b		x	12/09/92
3	8 (No Change)			03/12/91
3	9	x		06/18/90
3	9a		x	12/09/92
3	9b		x	12/09/92
3	10 (No Change)			09/13/83
3	17	x		06/18/90
3	17a		x	12/09/92
3	17b		x	12/09/92
3	18 (No Change)			06/18/90
3	20a	x		03/12/91
3	20b (No Change)			06/18/90
3	21	x		09/13/83
3	22	x		03/12/91
3	23 (No Change)			09/13/83

16. Technical Concurrence	17. Date

* "S" Indicates Supercedes Earlier Page; "A" Indicates Added Page

Specification Change Notice (SCN)

13. SCN No.	14. Pages Changed (Ind. Del.)	S*	A*	15. Date
3	24	x		09/13/83
3	27 (No Change)			09/13/83
3	28	x		06/18/90
3	28a	x		06/18/90
3	28b (No Change)			06/18/90
3	29	x		06/18/90
3	30	x		06/18/90
3	30a	x		06/18/90
3	30b (No Change)			06/18/90
3	32a	x		03/12/91
3	32b (No Change)			03/12/91
3	33	x		06/18/90
3	34	X		06/18/90
3	34a (Deleted)			06/18/90
3	34b (Deleted)			06/18/90
3	35	X		09/13/83
3	36	x		09/13/83
3	37	x		06/18/90
3	38	x		06/18/90
3	38a (Deleted)			06/18/90
3	38b (Deleted)			06/18/90
3	39	x		06/18/90
3	40	x		06/18/90
3	40a (Deleted)			06/18/90
3	40b (Deleted)			06/18/90
3	41	x		09/13/83
3	42	x		09/13/83
3	43	x		06/18/90
3	44	x		06/18/90
3	44a (Deleted)			06/18/90
3	44b (Deleted)			06/18/90
3	45 (No Change)			06/18/90
3	46	x		06/18/90
3	46a	x		06/18/90
3	46b (No Change)			09/13/83
3	49 (No Change)			06/18/90
3	50	x		06/18/90
3	50a	X		06/18/90
3	50b (No Change)			06/18/90
3	51	x		06/18/90
3	52	x		06/18/90
3	52a	x		06/18/90
3	52b (No Change)			06/18/90
3	53	x		03/12/91
16. Technical Concurrence		17. Date		

* "S" Indicates Supercedes Earlier Page; "A" Indicates Added Page

Specification Change Notice (SCN)

13. SCN No.	14. Pages Changed (Ind. Del.)	S*	A*	15. Date
3	54	x		03/12/91
3	54a	x		03/12/91
3	54b	x		03/12/91
3	54c	x		03/12/91
3	54d	x		03/12/91
3	54e	x		03/12/91
3	54f	x		03/12/91
3	54g		x	12/09/92
3	54h		x	12/09/92
3	54i		x	12/09/92
3	54j		x	12/09/92
3	54k		x	12/09/92
3	54l		x	12/09/92
3	54m		x	12/09/92
3	54n		x	12/09/92
3	54o		x	12/09/92
3	54p		x	12/09/92
3	54q		x	12/09/92
3	54r		x	12/09/92
3	54s		x	12/09/92
3	54t		x	12/09/92
3	54u		x	12/09/92
3	54v		x	12/09/92
3	54w		x	12/09/92
3	54x		x	12/09/92
3	55	x		09/13/83
3	56	x		03/12/91
3	56a	x		03/12/91
3	56b (No Change)			06/18/90
3	57	x		06/18/90
3	58 (No Change)			06/18/90
3	65 (No Change)			06/18/90
3	66	x		03/12/91
3	66a	x		03/12/91
3	66b	x		03/12/91
3	66c	x		03/12/91
3	66d	x		03/12/91
3	66e	x		03/12/91
3	66f	x		03/12/91
3	66g	x		03/12/91
3	66h	x		03/12/91
3	66i	x		03/12/91
3	66j	x		03/12/91
3	66k		x	12/09/92
16. Technical Concurrence		17. Date		

* "S" Indicates Supersedes Earlier Page; "A" Indicates Added Page

Specification Change Notice (SCN)

13. SCN No.	14. Pages Changed (Ind. Del.)	S*	A*	15. Date
3	66l		x	12/09/92
3	66m		x	12/09/92
3	66n		x	12/09/92
3	68a	x		06/18/90
3	68b (No Change)			06/18/90
3	69	x		06/18/90
3	70 (No Change)			06/18/90
3	71	x		06/18/90
3	72	x		06/18/90
3	79	x		03/12/91
3	80	x		03/12/91
3	83	x		03/12/91
3	84	x		03/12/91
3	84a	x		03/12/91
3	84b (No Change)			03/12/91
3	88e	x		03/12/91
3	88f	x		03/12/91
3	88g	x		03/12/91
3	88h	x		03/12/91
3	88i	x		03/12/91
3	88j	x		03/12/91
3	88k	x		03/12/91
3	88l	x		03/12/91
3	88m	x		03/12/91
3	88n	x		03/12/91
3	88o	x		03/12/91
3	88p	x		03/12/91
3	88q	x		03/12/91
3	88r	x		03/12/91
3	88s	x		03/12/91
3	89	x		09/13/83
3	90	x		09/13/83
3	91	x		09/13/83
3	92	x		09/13/83
3	93		x	12/09/92

16. Technical Concurrence	17. Date

* "S" Indicates Supercedes Earlier Page; "A" Indicates Added Page

1.3.13.2 Logic Low.- Unless otherwise specified, logic low shall be voltage higher than -0.6 volts dc but not to exceed 1 volt dc. It may also be defined by the numeral "0" or "LO".

1.3.14 Complementary metal-oxide semiconductor (CMOS) logic

1.3.14.1 Logic high.- Logic high shall be voltage higher than 9.5 volts dc but not greater than 15 volts dc. It may also be defined by the numeral "1" or "HI".

1.3.14.2 Logic low.- Logic low shall be voltage higher than -0.5 volts but not to exceed 3.6 volts dc. It may also be defined by the numeral"0" or "LO".

1.3.15 24-volt logic

1.3.15.1 Logic high.- Logic high shall be voltage equal or higher than 15 volts dc but not greater than 28 volts dc. It may also be defined by the numeral "1" or "HI".

1.3.15.2 Logic low.- Logic low shall be voltage equal or higher -0.5 volt dc but not to exceed 5 volts dc. It may also be defined by the numeral "0" or "LO".

1.3.16 Mean time between failures (MTBF).- MTBF is equal to the total operating hours of the equipment divided by the number of failures.

1.3.17 Mean time to repair (MTTR).- MTTR is the total corrective maintenance time divided by the total number of corrective maintenance actions.

1.3.18 Predicted MTBF.- The predicted MTBF is determined by reliability prediction methods based on the equipment design, the use environment,and the exponential distribution.

1.3.19 Predicted MTTR.- The predicted MTTR is determined by maintainability prediction methods based ont he equipment design, configuration, fault detection, and fault isolation techniques.

1.3.20 Remote maintenance monitoring system.- The Remote Maintenance Monitor System (RMMS) consists of the various sensors, micro-computers, instrumentation, and other microcomputer controlled circuits and equipment necessary to remotely monitor, control, analyze, record engineering data, and certify proper operation of equipment comprising the ALSF-2/SSALR as well as the overall ALSF-2/SSALR system. RMMS includes the Remote Monitor Subsystem (RMS), Maintenance Data Terminals (MDT), Maintenance Processor Subsystem (MPS) and the software/firmware necessary to make the system function.

1.3.20.1 Remote monitoring subsystem.- The Remote Monitoring Subsystem (RMS) is a subsystem of RMMS to provide for the collection, processing, control, and transmission of ALSF-2/SSALR equipment and environmental performance parameters.

1.3.20.2 Maintenance processor subsystem.- The maintenance processor subsystem (MPS) (not part of this specification) serves as the central processor for a defined geographical area. It acts as a control point to collect, record, and analyze monitored data from the ALSF-2/SSALR RMS. The MPS also can process commands to control ALSF-2/SSALR system.

1.3.20.3 Maintenance data terminal.- The maintenance data terminal (MDT) (not part of this specification) is a commercially available IBM PC/AT compatible personal computer. The MDT contains a keyboard, processor, monitor, and RS-232 port for use by field technicians in support of on-site maintenance responsibilities.

1.3.21 Specified mean time between failures.- The specified MTBF is the minimum acceptable MTBF, times the discrimination ratio.

1.3.22 Line replaceable unit (LRU).- The lowest unit to be replaced within the system during site maintenance. It is a separate, installable, physical package performing a single function or a group of closely related functions.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA specifications, drawings, and standards of the issues specified in the invitation-for-bids, or request-for-proposals form a part of this specification where specified herein:

FAA-D-2494	Technical Instruction Book Manuscript: Electronic, Electrical, and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books
FAA-E-982	PAR-56 Lampholder

2.1.1 FAA specifications

FAA-E-1100	Photometric Test Procedures for Condenser Discharge Lamp
FAA-E-1315	Light Base and Transformer Housing
FAA-E-2408	Lamps, PAR-56 Incandescent, Aviation Services
FAA-E-2491	Approach Light, Semiflush, Steady Burning
FAA-E-2604	Low-Impact Resistance Structure for Medium Intensity Approach Lighting System (MALS)

FAA-E-2690	Isolation Transformer for Approach Lighting System (1500 Watt)
FAA-E-2702	Low Impact Resistance Structure
FAA-G-2100	Electronic Equipment, General Requirement
AC 150/5345-47	Isolation Transformers for Airport Lighting Systems

THIS PAGE INTENTIONALLY LEFT BLANK

2.1.3 FAA standards

FAA-STD-013	Quality Control Program Requirements
FAA-STD-019	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
FAA-STD-020	Transient Protection, Grounding, Bonding, and Shielding Requirements for Equipment
FAA-STD-021	Configuration Management (Contractor Requirements)
FAA-STD-024	Preparation of Test and Evaluation Documentation
FAA-STD-025	Preparation of Interface Control Documents
FAA-STD-026	National Airspace System (NAS) Software Development
NAS-MD-790A	Remote Maintenance Monitoring System Interface Control Document, Maintenance Processor Subsystem to Remote Monitoring Subsystems and Remote Monitoring Subsystem Concentrators
NAS-MD-793	Remote Maintenance Monitoring System Functional Requirements for the Remote Monitoring Subsystem (RMS)
NAS-IR-5104 5100	Draft Interface Requirements Document, Maintenance Data Terminal (MDT)/Remote Monitoring Subsystem (RMS), dated October 9, 1989
FAA-AP-1990-4391	Draft Interface Control Document for the Terminal Control Computer Complex/Approach Lighting System (TCCC/ALS) 10/15/90

2.2 Federal publications. - The following federal publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and apply where specified herein.

2.2.1 Military standards

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-276	Impregnation of Porous, Nonferrous Metal castings
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility, Requirement for the Control of electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-470	Maintainability Program Requirements (For Systems and Equipments)
MIL-STD-471	Maintainability Verification, Demonstration, and Evaluation
MIL-STD-781	Reliability Tests, Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810	Environmental Test Methods
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment and computer software
DOD-STD-2167	Defense System Software Development

2.2.2 Military publications

MIL-HDBK-217	Reliability Stress and Failure Rate Data for Electronic Equipment
MIL-HDBK-472	Maintainability Predictions
RADC-TR-75-22	Nonelectronic Reliability Notebook

2.2.3 Military specifications

MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-C-7989	Covers, Light Transmitting, for Aeronautical Lights, General Specification for
MIL-C-13924	Coating, Oxide, Black, for Ferrous Metals
MIL-C-22896	Contractors
MIL-C-24308	Connector, Electric, Rectangular, Miniature, Polarized Shell, Rack and Panel, General Specification for
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirement for
MIL-C-26482	Connectors, Electronic, Circular, Miniature, Quick Disconnect

THIS PAGE INTENTIONALLY LEFT BLANK

MIL-E-917	Electric Power Equipment, Basic Requirements
MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts); Packing of
MIL-I-46058	Insulating Compounds, Electrical (for coating printed circuit assemblies)
MIL-M-38510	Microcircuits, General Specifications for
MIL-S-83731	Switch, Toggle, Unsealed and Sealed Toggle, General Specification for

2.2.4 Federal specifications

QQ-A-200/9	Aluminum Alloy Bar, Rod, Shapes, Tube and Wire Extruded, 6063
QQ-A-225	Aluminum and Aluminum Alloy Bar, Rod, Wire, or Special Shapes; Rolled, Drawn, or Cold Finished, General
QQ-A-250	Aluminum and Aluminum Alloy Plate and Sheet, General Specification for
QQ-A-591	Aluminum Alloy Die Castings
QQ-A-601	Aluminum Alloy Sand Castings
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for

2.3 Other publications.- The following publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of the specification.

2.3.1 National Fire Protection Association document

NFPA No. 70	National Electrical Code
NFPA NO. 78	Lightning Protection Code

2.3.2 Occupational Safety and Health Act (OSHA)

National Standards Established by Occupational Safety and Health Act (OSHA)

2.3.3 National Electrical Manufacturers Association

NEMA 4X	Dusttight, Raintight, Corrosion/Ice Resistant-Outdoor Enclosure
NEMA 12	Industrial, Dust-Tight, Drop-Proof Enclosure
NEMA FA1-3.01	Vibration Testing

THIS PAGE INTENTIONALLY LEFT BLANK

2.3.4 American National Standards Institute

ANSI C37.90	IEEE Guide for Surge Withstand Capability (SWC) Tests
ANSI C39.1	American National Standard for Electrical Analog Indicating Instruments
ANSI C62.1	Quantities and Units Used in Electricity

2.3.5 American Iron and Steel Institute standard

AISI	Stain and Heat Resistant Steel, No. 13

2.3.6 Electronic industries association

EIA-RS-232	Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange

2.3.7 Institute of Electrical and Electronic Engineers

IEEE-P1014	Proposed Standard for Versatile Backplane Bus

(Copies of this specification and other applicable FAA documents may be obtained from the Contracting Officer in the office issuing the invitation-for-bids or request-for-proposals. The requests should fully identify material desired; i.e., standard, drawing, specification, and amendment numbers and dates. Request should cite the invitation-for-bids, request-for-proposal, or contract involved or other use to be made of the requested material.)

(Requests for copies of military specifications and standards should be addressed to Naval Publications and Forms Center, Attention: NPFC-105, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

(Information on obtaining copies of federal specifications and standards may be obtained from General Services Administration offices in Washington, DC.; Atlanta; Auburn, Washington; Boston; Chicago; Denver; Kansas City; New York; San Francisco; and Seattle.)

(Information on obtaining NFPA documents may be obtained from the National Fire Protection Association, Battery March Park, Quincy, Massachusetts 02269.)

(Information on obtaining OSHA standards may be obtained from Department of Labor, Occupational Safety and Health, Constitution Avenue & 14th Street, NW., Washington, DC.)

(Information on obtaining NEMA publications may be provided by the National Electrical Manufacturer's Association, 2101 L Street, NW., Washington, DC 20037.)

(Copies of the AISI standards can be obtained from the American Iron and Steel Institute, 1000 16th Street, NW., Washington, DC 20036)

3. REQUIREMENTS

3.1 General.- The equipment furnished under this specification shall provide approach lighting for use on selected runways. The Approach Lighting System (ALS) shall be switchable from the High Intensity Approach Lighting System with Sequenced Flashing Lights, Category II (ALSF-2) mode, to the Simplified Short Approach Light System with Runway Alignment Indicator Lights (SSALR) mode. The patterns produced by these two lighting modes are shown in plan view by figures 1 and 2 respectively. The system shall be capable of providing the 3,000-foot (914 m) patterns as shown where glide slope angle restrictions require it, and also the shorter 2,400-foot (732 m) patterns for use on other domestic Category II Runways (without the last six stations). The steady burning approach lights will be connected in three constant current lighting loops as shown on FAA Drawing D-6238-4. Switching between the modes (ALSF-2/SSALR) will be locally controlled from the substation and remotely controlled from the airport traffic control tower (ATCT) via the control subsystem, which will activate the mode change relays in the substation high voltage output cabinet (refer to FAA Drawings D-6238-22 and D-6238-23). The action of this relay will reconfigure the ALS field wiring as shown in the simplified schematic figure 3. Operational modes of the flashing lights will be switched by selectively activating the appropriate trigger signals upon command from the ATCT. The approach lighting system will use low impact resistance structures, will employ constant current lighting techniques, and will have remotely indicated fault sensing equipment. The substation equipments (regulators, high voltage cabinets, Remote Monitoring Subsystem and control and monitor subsystems) will be installed in an environmentally controlled shelter that is generally located within the runway approach zone. This shelter is not a part of this specification; however, it will provide protection for some of the equipment. The shelter equipment arrangement and detailed mounting provisions are as shown on FAA Drawings D-6238-17 and D-6238-21. The system equipment and interconnection shall comply with the National Electrical Code (NEC) and Occupational Safety and Health Act (OSHA). The required system shall be as shown in the functional block diagram, figure 4. This specification also covers reliability and maintainability design and prediction requirements imposed on the contractor. The design shall include a requirement for a remote maintenance monitoring system capability. For each circuit card assembly type, the contractor shall provide one site spare.

3.1.1 Equipment to be supplied by the contractor.- The ALSF-2/SSALR systems shall be complete in accordance with all specification requirements and shall include the items listed

THIS PAGE INTENTIONALLY LEFT BLANK

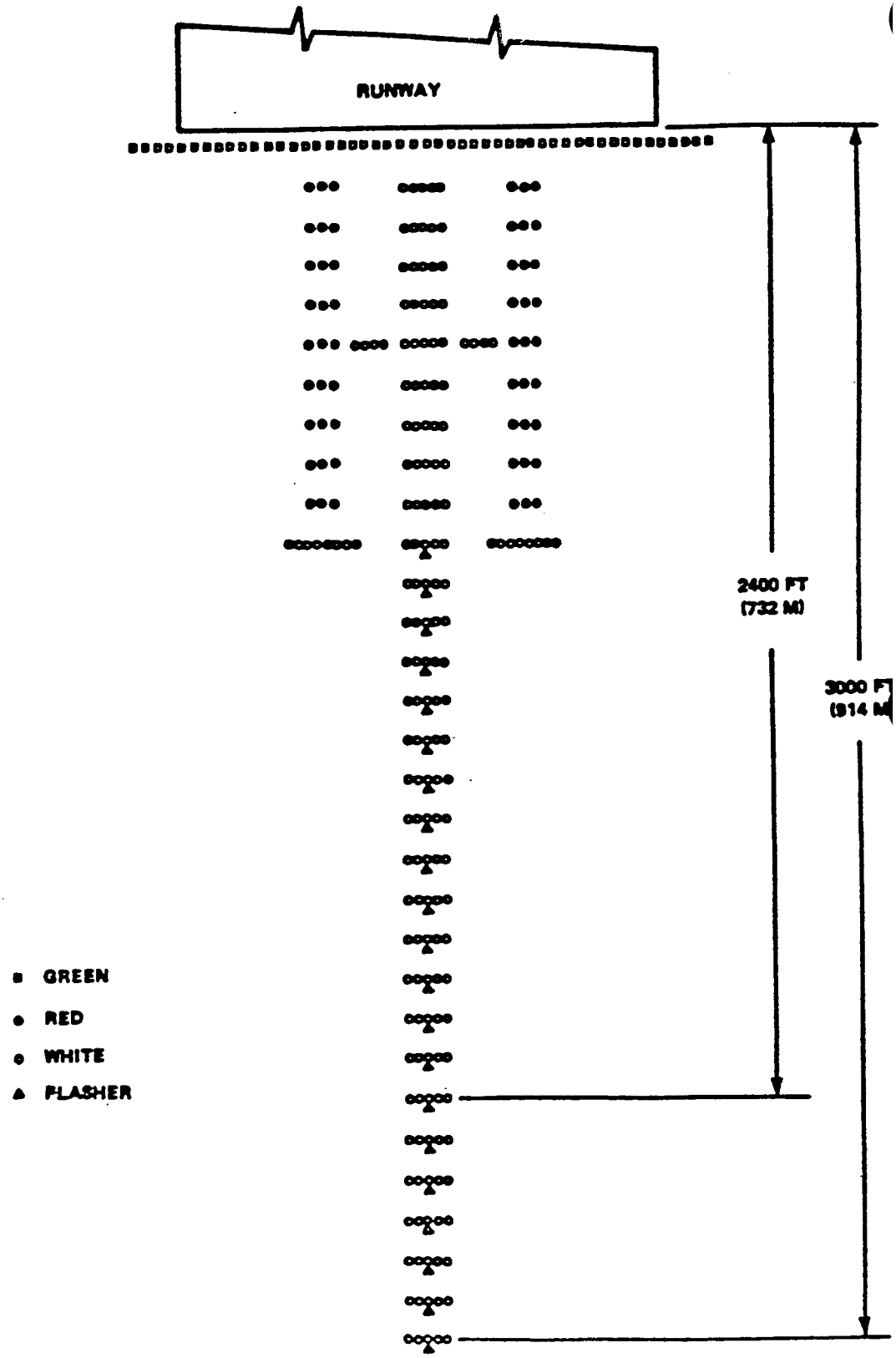

Figure 1. ALSF-2 Lighting Pattern

3.2.2.4 Instrument potential transformers.- Potential transformers (GE 643X87, or equal) shall be installed to allow monitoring of output loop voltages. Transformers shall have both legs of the primary circuits fused. The output of potential transformers shall be wired to the output terminal board as shown on FAA Drawings D-6238-22 and D-6238-23. The ratio of these transformers shall be 20:1. They shall provide inputs to both the light field monitoring circuits and the output voltage meter located in the substation control and monitor assembly.

3.2.2.5 ALSF-2/SSALR mode change relays.- High performance vacuum relays having contacts rated at 25 A, 5000 V peak to ground continuous duty shall be installed to select ALSF-2 or SSALR light field configuration as shown on FAA Drawings D-6238-22, D-6238-23, and D-6131-31.

3.2.2.6 Service exit.- A service exit shall be made through precut holes in the bottom of the cabinet as shown on FAA Drawing D-6131-32.

3.2.3 Constant current regulator.- Three 50 KW constant current regulators shall be supplied for each system, one for each steady burning lighting loop as shown on FAA Drawing D-6238-4. The regulators shall all be commanded simultaneously by the control subsystem and each shall:

(a) Operate from a 2,400 V ac, single phase, 2-wire 60 Hz source.

(b) Provide output current monitoring meter.

(c) Have 24 V dc logic levels (see 1.3.15) for control and status signals.

(d) Provide regulated constant current to series lighting loops that is variable in 5 discrete steps as a function of selected brightness.

Provisions shall be made for stepped-brightness selection without interrupting load current. The assembly shall have an isolation transformer, a current detecting system, transient suppressor, brightness selection control circuitry, open-circuit and over current protection, and an output current meter. Solid-state electronic circuitry and fixed winding transformers or reactors shall be used to accomplish regulation at the various brightness steps. (No moving coil or other mechanical apparatus shall be used for regulation.) Relays may be used for on/off control of the high voltage input but all control and monitoring interfaces shall be solid-state and shall have 24 V dc logic levels as defined in 1.3.15.

3.2.3.1 Input power.- The regulator shall operate without degraded performance with input voltages ranging from 2,280 to 2,640 C ac, 60 Hz single phase.

3.2.3.2 Output regulation.- The regulator shall automatically maintain its normal output current within the limits set forth in

THIS PAGE INTENTIONALLY LEFT BLANK

table I for all input voltages as specified in 3.2.3.1 and for all variations in output load from short circuit to full load (50 KW). The assembly shall meet these same requirements with 10 percent of the total load (5 KW) consisting of suitably loaded isolating transformers which are then open-circuited at their secondaries.

3.2.3.3. Efficiency.- The efficiency of the regulator shall be greater than 93 percent at maximum brightness with an input voltage of 2,400 V ac, unity power factor load, and at an ambient temperature of 77 degrees F (25 degrees C). The efficiency shall be measured at rated load.

3.2.3.4 Power factor.- The regulator power factor shall be equal to or greater than 0.95 at rated load (50 KW) in step 5 with a resistive load. The power factor shall always be lagging and shall not be less than 0.5 for any intensity step in the ALSF-2 mode or the SSALR mode, in which the power consumed by the load is equal to or greater than 10 percent of the full rated regulator capacity. Power factor correction, if needed, shall be internal to the regulator, and shall be switched as required to maintain a lagging power factor equal to or greater than 0.5 and less than 1 in step 5 for a resistive load of 5 KW to 50 KW.

3.2.3.5 Temperature rise.- The temperature rise for primary and secondary windings, as determined by the resistance method, shall not exceed 149 degrees F (65 degrees C) when operated at full load and unity power factor. Oil temperature, within 3 inches (76 mm) of the top and 3 inches (76 mm) of any side wall of the tank, shall not exceed 131 degrees F (55 degrees C rise when operated in an ambient environment of 77 degrees F (25 degrees C). Dry type regulators shall have Type H insulation temperature characteristics in accordance with MIL-E-917.

3.2.3.6 Output isolation.- The regulator output shall be electrically isolated from the input and shall also be floating (not grounded).

3.2.3.7 Open-circuit protection.- An open-circuit protection feature shall be provided such that the regulator will be automatically switched off within 2 seconds after the output circuit is opened. Upon removal of the open circuit, the regulator shall not automatically restart. In order to restart the regulator, the regulator on/off control circuit (either local or remote) shall be cycled through the off position and returned to the on position to reset the open-circuit protection feature.

(e) Contain the substation control panel (see figure 5) for controlling the operation of the system including:

(1) Power on*

(2) Power off

(3) Approach lights on

(4) Approach lights off

(5) Flashing lights on

(6) Flashing lights off

(7) Mode ALSF

(8) Mode SSALR

(9) Alarm status (caution, failure, communication fault)

(10) Control source local

(11) Control source remote

(12) Output voltage phase selectors

(13) Output voltage loop selectors

(14) Lamp test

*The control panel power on switch/indicator (3.2.4.1 (e) (1), shall not be used to directly switch the 120 V ac power to the electronic circuits. Instead, a solid-state switch or relay controlled by the switch/indicator shall be used to switch the 120 V ac power. A master power switch that will disconnect the incoming 120 V ac power to the cabinet shall be installed in the cabinet, adjacent to the 120 V ac power fuse.

THIS PAGE INTENTIONALLY LEFT BLANK

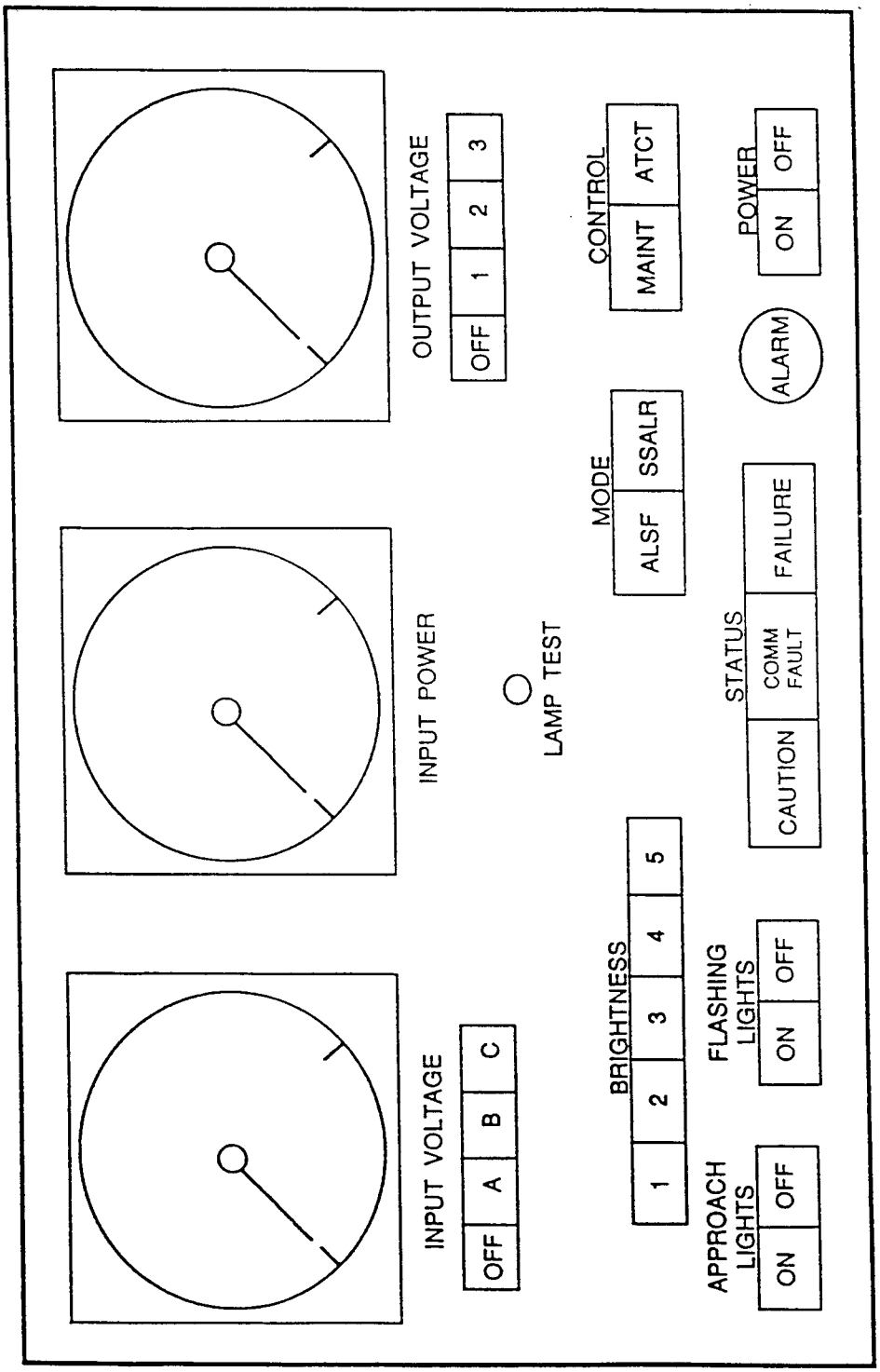

Figure 5. Typical Substation Control Panel

(f) Contain the electronic circuitry required to receive commands from the remote or local control panels, solve the required control algorithms, format and distribute the commands to the output devices (regulators, flashers, mode change relay), and distribute status and alarm signals to monitoring and display devices.

(g) Contain the electronic circuitry required to detect the number of failed lamps in each of the three current loops in brightness level settings (B1 to B5) and both modes (ALSF-2 and SSALR). When a specified number (adjustable) of failed lamps is detected in any loop, the monitor shall transmit caution and failure alarms to the control electronics. (See 4.4.8.1.)

(h) Contain the electronic circuitry required to provide remote maintenance monitoring and control.

(i) Feature elapsed time indicator(s). The indicators shall provide the capability of measuring the operating time in brightness one (1) and two (2); measuring the operating time in brightness three (3); measuring the operating time in brightness four (4); and measuring the operating time in brightness five (5). (See 3.2.4.4.7.)

(j) Contain electronic circuitry required to interface the ALSF-2/SSALR to the terminal control computer complex.

3.2.4.2 Remote electronic chassis.- The remote electronic chassis shall provide an interface function between the remote control panel and the substation control and monitor assembly. Its purpose is to perform those electronic functions required by the ATCT and the communications link without using ATCT control panel space. The tower control panel shall interface with the remote electronic chassis via a multiconductor cable. The operation of the system shall not be degraded by any length of cable up to a maximum of 300 feet (91.44 m). The remote electronic chassis shall contain the following functional hardware:

(a) Communication data modems, including clock generators

(b) Indicator lamp drivers (solid-state)

(c) Logic required to format data, interlock control functions, control and mute the audible alarms, and sense up-link communication failures

(d) Power supplies required for logic, communications, and display circuits (120 V ac input)

(e) Engine-generator (E/G) interface circuits

3.2.4.3 Remote control panel.- The remote control panel (see figure 6) shall:

(a) Have no electronic components. Electronic functions shall be performed by the remote electronic chassis. (See 3.2.4.2)

(b) Have switch/indicators to control and display the status of the following functions.

(1) Brightness (1-5)

(2) Mode (ALSF-2/SSALR) (E/G on when ALSF-2 is on)

(3) Approach lights (on/off)

(4) Flashing lights (on/off)

(5) Alarm status (caution, failure, communication fault)

(6) Control status - tower or substation (indicator only)

(7) Runway number

(8) Lamp test (part of runway number module)

(c) Have a control to dim the panel lights.

(d) Have an audible alarm to draw attention to indicated faults.

3.2.4.4 Control subsystem.- The control subsystem shall be designed in three major assemblies as required in 3.2.4 and shall have the features specified herein.

3.2.4.4.1 Switch/indicators.- The switch/indicator modules used on the local and remote control panels shall be Korry Model 432 or equal and shall be grouped, labeled, and have legends as shown on figures 5 and 6. Each module shall:

(a) Have at least two 28 V dc lamps per indicator (four lamps for split legend lenses).

(b) Allow relamping from the front.

(c) Provide TTL compatible signals to control electronic circuitry.

(d) Have the legends in black letters, visible at all times on white background, which illuminates in color when energized.

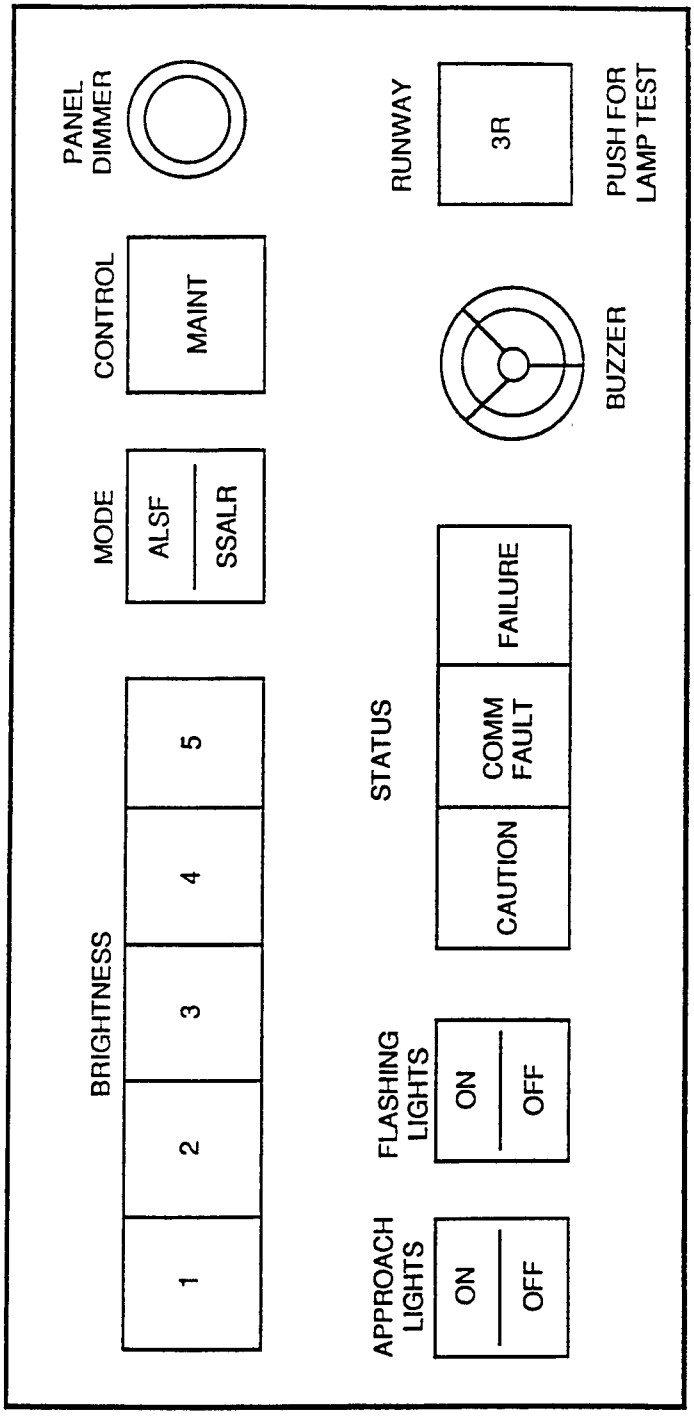

Figure 6. Typical Remote Control Panel

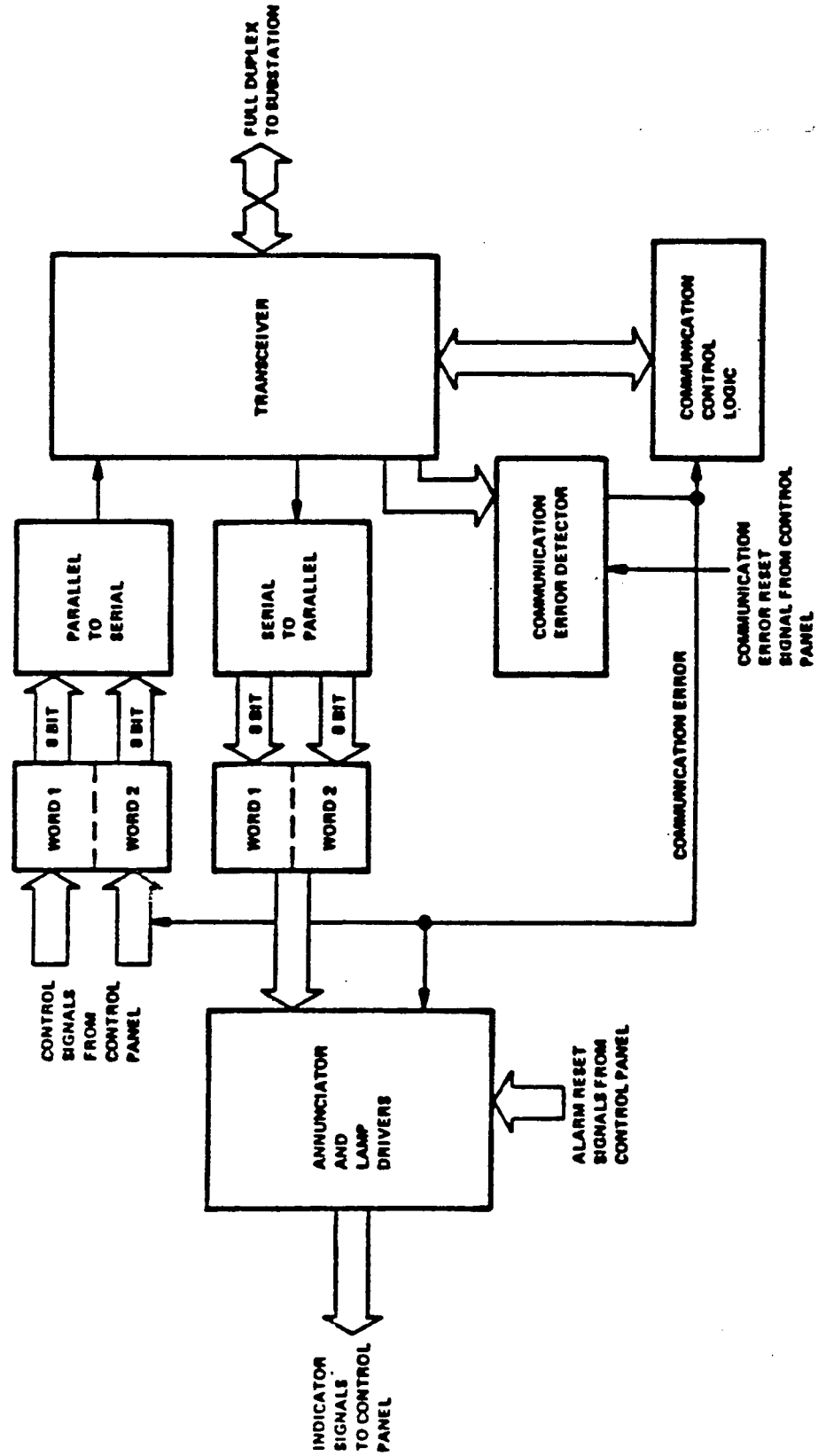

Figure 8. Remote Electronic Chassis Block Diagram

3.2.4.4.2.1 MAINT/ATCT control.- Data upon which the system operates shall originate from either the remote control panel via data link or from the substation control panel. When the position of the substation MAINT/ATCT switch is in the MAINT position, data shall originate from the substation panel and the air traffic control tower MAINT indicator shall be illuminated. When in the ATCT position, the data shall originate from the remote control panel. If any of the control equipment (regulators or flashers) is placed in a local control mode via its own independent (local/remote) switch when the substation (or tower) is in the ATCT mode, the air traffic control tower MAINT indicator shall be illuminated along with an audible alarm and the substation MAINT/ATCT indicator shall blink (see 3.2.4.4.2.8).

3.2.4.4.2.2 Brightness control.- Logic shall be provided to cause the selected brightness to be activated by the regulators, monitor, and flasher equipment. The flasher shall be commanded to LOW intensity for brightness steps 1 or 2, to MEDIUM for step 3, and to HIGH for steps 4 or 5. The brightness control switches shall be mechanically interlocked. Depression of any switch shall release any other switch; and switch 5 shall not latch in the depressed state, but shall release all others when it is depressed.

3.2.4.4.2.3 Brightness 5 control logic.- Logic shall be provided to prevent brightness 5 from remaining active for more than 15 minutes ±10 seconds without reinitiating the command. Brightness 5 is a momentary signal and must be electronically latched. Brightness 5 is a momentary signal and must be electronically latched. Once latched, the brightness 5 control shall be active for only 15 minutes, unless reinitiated during the 15 minute period. At 14.5 minutes ± 10 seconds, an alert signal shall be generated and sent to the control panel to "beep" the alarm and cause the B5 indicator lamp to blink. At the end of 15 minutes, the B5 control latch shall be reset and B4 logic activated, causing the lighting system to switch into brightness 4. Until any brightness level is selected, the system shall remain in brightness 4 and the alert signal shall remain active, causing the B4 indicator to blink, indicating that the actual brightness is not as selected by the operator. When there is a power source transfer from commercial power to engine generator power, the brightness level will step from brightness 5 to brightness 4 for a period of 10 seconds after which it will retain brightness level 5. This is accomplished by 2 additional terminals connected to the engine generator "on" switch. These two terminals shall be transient protected and identified as "engine generator set back." The voltage at these two terminals shall be 24 V dc.

3.2.4.4.2.4 Regulator control.- The logical control algorithm for the regulator on/off and brightness control functions shall be such that, when a regulator is turned on, it is turned on with B1 selected and after a 3.5 second time delay, the desired brightness is selected. The delay allows the steady burning lamps to come up to operating temperature before large energy output conditions are imposed on the system. After initial warm up, it shall be possible to select any brightness without additional delays. The 3.5 second time delay shall not be used when the regulator is turned off by input power interruption and then to on when input power returns, such as occurs when power is transferred from engine generator to commercial power using the E/G transfer switch.

3.2.4.4.2.5 Flashing light control.- Logic signals shall be provided to turn the flashing lights on/off, change modes, or change brightness upon command. No special timing considerations of these signals are required.

3.2.4.4.2.6 Mode change logic.- Logic shall be provided to inhibit the changing of system mode (ALSF/SSALR) when any of the three regulators is in the ON condition. Mode changing shall be inhibited even if regulator power is turned on at the regulator local control switch. In addition, when a mode change is commanded from the control panel either locally or remotely, the logic automatically shall turn the regulator power off, change the mode, and sequence the power back up to the selected brightness.

3.2.4.4.2.7 Alarm.- An audible electronic signal shall be provided and shall output a steady tone of 1000 Hz $\pm$500 Hz with a sound level output of 55 to 70 decibels (Db). The sound level adjustment control shall be located inside the enclosure and behind the remote control panel. The alarm operates as follows:

(a) When a failure condition is received from either the strobe light (flasher) control system or the ALS operational monitor subsystem, it shall initiate a steady tone until the FAILURE pushbutton is depressed. The continuous tone shall stop after the switch is depressed until a new failure condition occurs. The failure indicator light shall remain lit until the failure condition is removed.

(b) When a communications fault occurs, the alarm shall initiate a beeping mode where the tone is emitted for 0.33 seconds and is off for 0.66 seconds. The beeping shall continue until the COMM FAULT pushbutton is depressed. It shall not reenter the continuous beep mode until after the fault condition is cleared and new

THIS PAGE INTENTIONALLY LEFT BLANK

fault is detected. After the pushbutton is depressed the COMM FAULT light will remain lit until the fault condition is removed.

(c) When caution signal is received from either the flashing lighting system or the ALS monitor subsystem, the alarm shall emit a single 0.2 second tone. It shall emit this tone each time a caution condition occurs. The caution light shall remain lit until the condition is removed.

(d) Whenever a mode error is detected, when both the steady burning and the flashing lights are not in the same mode (ALSF/SSALR), a single 0.1 second tone shall be generated. The ALSF-SSALR status indicator shall blink until the steady burning and flashing lights have both switched to the mode selected. Detection of this error shall be inhibited for 1 second after a mode change is requested.

(e) Whenever the brightness 5 timer passes either the 14.5 minute warning, or switches to B4 at 15 minutes, a single 0.1 second tone shall be generated.

(f) The previously described modes shall operate independently. For example, if a communication fault and a failure condition existed simultaneously, the alarm would emit a continuous tone. If the FAILURE pushbutton was depressed, the alarm would start beeping until the COMM FAULT pushbutton is depressed. If a caution signal were to occur, the alarm would beep once. The substation alarm shall not be active when the system is in ATCT mode nor shall the tower alarm be active when the system is in MAINT mode.

3.2.4.4.2.8 Blinking.- An oscillator signal shall be provided for the blinking of indicator lights or the beeping of alarms. This signal shall have an on-time of 0.33 seconds and an off-time of 0.66 seconds.

3.2.4.4.2.9 Transients.- All switching transients shall be suppressed using low pass filtering techniques as required. Switching at any point in the system shall not cause undesired action at any other point.

3.2.4.4.3 Data transmission.- The remote electronic chassis and the substation control and monitor assembly shall be connected together via a 2 wire, half duplex, phase coherent, frequency shift keyed (fsk) data link.

The transmission shall be a synchronous, serial binary, shall have the characteristics required in table II, and shall detect communications errors as required by 3.2.4.4.3.3. The transmission link is required to operate with at least an 8 Db signal-to-noise ratio over a distance of 10 miles (16 km) or more without intermediate boosters or line amplifiers. Loss of communications shall not cause the activation of erratic modes of operation. The two wire transmission lines shall terminate in the remote electronic chassis and the substation control and monitor assembly in differential amplifier input circuitry that eliminates line noise from the transmitted and received signals.

Table II. Transmission Characteristics

Rate	.10 words/sec. minimum
Frequency tolerance	.0.5% max.
Output impedance	.600 ohms
Transmitter output level	.-12 Dbm to 0 Dbm (Adjustable)
Receiver dynamic range	.-50 Dbm to 0 Dbm
Bit error rate (8 db S/N)	.1 x 10-5 max
Peak-to-peak jitter	.5% max
Carrier detect threshold	.-50 Dbm

3.2.4.4.3.1 Frequencies.- The ATCT to substation communication link (downlink) shall transmit 1270 Hz and 1070 Hz for mark and space, respectively. The substation to tower link (up-link) shall transmit 2225 Hz and 2025 Hz for mark and space, respectively. ATCT and substation receiver frequencies shall be compatible.

3.2.4.4.3.2 Data framing.- Two 8-bit data words shall be transmitted, alternately. A universal asynchronous receiver/ transmitter (UART) shall be utilized to frame each word. The data word shall consist of a start bit, 8 data bits, a parity bit, and 2 stop bits. The parity bit shall be implemented to provide odd parity. Data bit 1 shall be used for word identification, with "0" denoting word 1, and "1" denoting word 2. Unused data bits shall be set to zero. Data formats shall be as shown in table III.

3.2.4.4.3.3 Communications fault.- A communications fault (COMM FAULT) condition is defined as an up-link carrier loss, parity error, framing error, or overrun error. Upon detection of a communications fault, the control logic shall hold the last valid command. Four classes of errors shall be detected by the serial data interface and are defined as follows:

(a) Carrier loss - Generated if the carrier is not received.

(b) Parity error - Generated if parity bit is erroneous.

(c) Framing error - Generated if received data does not have a valid stop bit.

(d) Overrun error - Generated if data is not transferred to the receiver holding register before next character read.

3.2.4.4.3.4 Lightning protection.- Lightning protection, conforming to FAA-STD-019 and FAA-STD-020, shall be provided for all communication and power conductors and shall be installed as near as possible to their point of entrance into the housing. The arresters shall be properly combined, where necessary, to meet the circuit voltage requirements (see 3.6.6).

THIS PAGE INTENTIONALLY LEFT BLANK

output voltage. Meters may be either analog or digital type. Digital display type meters shall be submitted for approval before use in the system. All meter terminals shall be insulated to prevent electrical shock hazards to the technicians. Analog meters shall have an accuracy of ± 2% or better of the full scale reading. Digital type meters shall have and accuracy of at least ± 1%.

3.2.4.4.5.1 Input power metering.- The input wattmeter shall be a 3 phase, 4-wire, 50/60 Hz, integral transducer. Meters shall have a 200 kW capacity. Voltage inputs to the wattmeter are derived from three potential transformers located within the high voltage input cabinet of the substation. Currents are derived from current transformers located within the high voltage input cabinet.

THIS PAGE INTENTIONALLY LEFT BLANK

3.2.4.4.5.2 Input voltage metering.- The input voltage meter shall be transformer rated (50/60 Hz). Full scale for the voltmeter shall be 3,000 volts. If an analog meter is used, the meter shall have a 50 degree scale of 6.9 inches (175 mm) in length. Voltage input to the meter may be derived from the potential transformers used with the wattmeter input. Pushbutton switches shall be provided to select phase A, B, or C voltages and to turn the voltmeter off.

3.2.4.4.5.3 Output voltage metering.- The output voltage meter shall be identical to the input meter and may be supplied from potential transformers located within the substation high voltage output cabinet. Inputs to the meter shall be through pushbutton switches to allow selection of loop 1, 2, or 3 and to turn the meter off.

3.2.4.4.6 Power requirements.- The system shall contain all power supplies required for operation and shall utilize 120 V ac, 60 Hz, single phase power input, both for the remote electronic chassis and the substation control and monitor assembly.

3.2.4.4.7 Elapsed time indicator(s).- The Elapsed time indicator(s) shall be installed behind the top front panel of the control and monitor cabinet to indicate the number of hours of operation of the approach lights. The indicator(s) shall indicate hours of operation in brightness 1 and 2. The indicator(s) shall indicate hours of operation in brightness 3. The indicator(s) shall indicate the hours of operation in brightness 4. The indicator(s) shall indicate the hours of operation in brightness 5. The indicator(s) shall indicate up to 99,999 hours and indicate the total time in hours and 10ths of hours. The indicator(s) shall be a recycling type(s). The total time shall be retained after loss of power. Time data derived from these indicator(s) shall be transmitted and be available to the remote monitoring subsystem.

3.2.4.5 Operational monitor subsystem.- The operational monitor subsystem shall monitor the ALSF-2 and SSALR modes and provide the substation control panel (figure 5) and the remote control panel (figure 6) with the operational status (indicator lights) of the system. The operational monitor subsystem shall provide an indication of the brightness level settings, B1 through B5. The input voltages, system power, the output voltages, and the current in each of the three current loops at each of the brightness levels shall be monitored. The monitor shall detect, at all brightness levels in each current loop, regulator failure,

lamp failure, over-current or over-voltage outputs, open or shorted loop conditions and provide caution or failure signals, as applicable. The operational monitor subsystem shall provide caution and failure signals suitable for combining with other system caution and failure signals for display on the substation control and monitor assembly and remote control panels. When MPS or maintenance takes control of the system, the monitor caution and failure signals shall provide both an audible and visual indication in accordance with 3.2.4.4.2.7. If a central processing unit (CPU) or any device requiring programming is used, the device(s) shall automatically reset if it malfunctions or when a lock-up condition occurs. Complete removal of the operational monitor subsystem shall not affect the operation of the ALSF-2/SSALR system.

3.2.4.5.1 Monitor performance.- The operational monitor subsystem shall reliably detect and indicate when a 300 watt or a 500 watt lamp ceases to function. The monitor shall be capable of associating each failed lamp with lamp bars so the required generation of caution and failure signals as shown in table VI can be met. The monitor shall distinguish between a lamp failure, a failed shorting device, temperature and humidity caused circuit changes, lamp aging, insulation leakage, and high resistance connections.

3.2.4.5.2 Caution and failure conditions.- The operational monitor subsystem shall be designed and delivered to produce caution and failure signals when any one or more of the standard conditions listed in table VI exist.

3.2.4.5.3 Caution and failure selection range.- The operational monitor subsystem shall permit selection of different caution and failure lamps out and bar quantities from the standard conditions described in Paragraph 3.2.4.5.2. The selection range shall be from 0 or at least 2 lamps less than the standard to twice the standard lamp quantities.

3.2.4.5.4 Failed lamp simulation.- The operational monitor subsystem shall provide a means to simulate failed lamps for all caution and failure conditions in order to verify correct operation of the subsystem.

TABLE VI. Caution and Failure Criteria

Parameter	Normal	CAUTION	FAILURE
ALSF-2 Mode			
a. Centerline Bars			
1. Centerline Bars, inner 1500-feet	All lamps on	2 consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	3 or more consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 20 percent of lamps out (random)
2. Centerline Bars, outer 1500-feet	All lamps on	2 consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	3 or more consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 20 percent of lamps out (random)
b. Side row bars	1 lamps on	2 consecutive light bars out (2 or more lamps out in a 3-lamp bar); more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	3 or more consecutive light bars out (2 or more lamps out in a 3-lamp bar); more than 20 percent of lamps out (random)
c. Threshold bar	All lamps on	3 adjacent lamps out; more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	4 or more adjacent lamps out; more than 20 percent of lamps out (random)

TABLE VI. Caution and Failure Criteria (Continued)

Parameter		Normal	CAUTION	FAILURE
d.	500-foot bar	All lamps on	3 adjacent lamps out; more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	4 or more adjacent lamps out; more than 20 percent of lamps out (random)
e.	1,000-foot bar	All lamps on	3 adjacent lamps out; more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	4 or more adjacent lamps out; more than 20 percent of lamps out (random)
f.	Flashers	Flashers operating	2 flashers out (random)	2 or more flashers out (consecutive); 3 or more flashers out (random)
SSALR Mode				
a.	Overall System	All lamps on	1 light bar out (3 or more lamps out in a 5-lamp bar, 4 or more lamps out in the threshold bar, 4 or more lamps out in the 1000-foot bar); more than 17 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	2 or more light bars out (3 or more lamps out in a 5-lamp bar, 4 or more lamps out in the threshold bar, 4 or more lamps out in the 1000-foot bar); more than 20 percent of lamps out (random)
b.	Threshold bar	All lamps on	3 lamps out	4 or more lamps out
c.	1,000-foot bar	All lamps on	3 lamps out	4 or more lamps out

TABLE VI. Caution and Failure Criteria (Continued)

Parameter	Normal	CAUTION	FAILURE
d. Flashers	All flashers operating	1 flasher out	2 or more flashers out

Note 1: A 5-lamp bar is considered non-operating when the bar has 3 lamps out.

Note 2: A 3-lamp bar is considered non-operating when the bar has 2 lamps out.

3.2.4.5.5 Operational monitor interface.- The following monitor interfaces are discussed below:

(a) Loop voltage and currents

(b) Lamp bar/lamp failure detection

(c) Flasher light failure detection

(d) Control panel signals

3.2.4.5.5.1 Loop voltage and current monitoring.- If the operational monitor subsystem requires loop voltage sensing, it shall be obtained from the secondary of a 20 to 1 stepdown voltage transformer located in the high voltage output cabinet. If loop current sensing is needed, it shall be obtained using a current transformer located in the high voltage output cabinet.

3.2.4.5.5.2 Lamp/bar failure detection.- Monitoring shall be provided at each lamp bar to provide for the detection of a lamp failure in each of the light bars specified in 3.2.4.5.2. Any monitoring sensor components used at or near the lamp shall fit within the lamp holder. Lamps where power is supplied by 1500 watt transformers shall have shorting devices. Shorting devices are optional for single lamps where power is supplied by 300 watt or 500 watt transformers.

3.2.4.5.5.2.1 Reference lamps.- If reference lamps are used, they shall be connected into the system with a shorting device and an isolation transformer to provide consistency with the other lamp installations. The reference voltage input to monitor the circuitry shall be protected against the high voltage that will be applied to the input when the isolation transformer has a high impedance load or no load because of lamp and shorting

device failure. Failure of the reference lamp(s) shall not affect the operation of the monitoring systems or the lighting system.

3.2.4.5.5.2.2 Lamp monitor wiring.- Only two (2) power wires from the isolation transformers' secondary to the lamp bar are allowed. Monitoring circuitry and wiring to the operational monitor in the substation are not limited. On lamps mounted on frangible couplings, two monitor wires are permitted provided the two monitor wires have a quick disconnect at the frangible coupling and fit into the frangible coupling along with the L-823 connector. The two monitor wires shall be a length of at least 8 feet. The monitor wires and connector shall be designed to operate in a wet, oily environment. Any monitor sensor component shall fit within the lamp holder. All terminations and termination enclosures shall be provided by the contractor.

3.2.4.5.5.3 Flasher light failure detection.- Flasher light caution and failure signals shall be provided to the operational monitor subsystem for integration with the caution and failure signals for both the substation and ATCT control panel indicators.

3.2.4.5.5.4 Control panel signals.- The ALS operational monitor subsystem shall be controlled by seven input control signals originating at the control subsystem. These signals provide system status information to the monitor as required to normalize the computations as a function of brightness and mode. The logic levels on input control signals shall be as specified in table VII.

3.2.4.5.6 Calibration.- Calibration of the monitor subsystem shall be automated as much as practical. A means to initiate calibration shall be provided at the substation. The operational monitor subsystem shall automatically compensate for temperature and humidity changes, lamp changes due to age, series loop impedance changes, and defective shorting devices. Calibration requiring human intervention shall not be required more often than quarterly. Calibration methods requiring the physical removal of lamp(s) are discouraged. Component selection and circuitry shall be designed for low long-term drift characteristics. The stability of the monitor shall be such that periodic adjustment shall not be required more often than every 3 months due to drift in the monitor circuit components. It shall take no longer than 30 minutes for one person to make the required adjustments or calibration.

Table VII. Monitor Interface

Commands			Status		
Signal	Logic HI	TB Mark	Signal	Logic HI	TB Mark
On/Off	On				
B1	HI in selected brightness	B1	Caution	CAUT	
B2		B2	Failure	FAIL	
B3		B3			
B4		B4			
B5		B5			
Mode	ALSF				

3.2.4.5.7 Non-volatile status.- The monitor subsystem shall maintain the status of failed lamps in each lamp bar in non-volatile memory. The operating times of the system in each mode and for each brightness level shall also be maintained in non-volatile memory. The memory shall be updated during normal shutdown and frequently enough during operation so that reasonably accurate status is recorded in the event of abnormal shutdown. When powered up, the operational monitor subsystem shall retrieve stored status and then update it with changes that occurred while it was off.

3.2.4.5.8 Diagnostic program.- When a microprocessor is used in the operational monitor subsystem to process the monitored signals, a diagnostic program shall be provided for testing the system's operational program. The diagnostics program shall test the addressing data output, data input, and the internal logic operation of the microprocessor. It shall also check the timing and data paths of the RAM, PROM, and PAL components located on the microprocessor board. The testing program shall provide the proper operation and delineate alarm indication and location of any malfunction found. The diagnostic program software shall be included in the equipment instruction book with the operational program software. A caution signal shall be generated when the diagnostic routine finds a malfunction or failure.

3.2.4.5.9 Outputs to remote monitoring subsystem (RMS).- All of the data provided by table VI, status of caution and failure signals, and all data sensed by the monitoring subsystem shall be accessible to the RMS.

3.2.4.5.10 Data archiving.- The monitoring subsystem shall produce, every 15 minutes, a historical record of the operating mode, brightness level, status of lamps burned out in each lighting group or bar, and the status of caution and failure signals.

3.2.4.5.11 Lightning protection.- A lightning and surge protection system, meeting the requirements of FAA-STD-019 and FAA-STD-020, shall be employed to protect the monitor subsystem.

3.2.5 Flashing lights subsystem.- The flashing light section of the ALSF-2 system will consist of a maximum of 21 flashers for a 3,000 feet (914 meters) ALS, and a minimum of 15 flashers for a 2,400 feet (732 meters) ALS. The flashing light section of the SSALR system will consist of a maximum of 8 flashers for a 3,000 feet (914 meters) ALS and a minimum of 5 flashers for a 2,400 feet (712 meters) ALS. The flasher subsystem shall consist of a flasher master controller unit, junction boxes, and

flasher assemblies. Flasher assemblies may be either elevated (Type I) or semiflush (Type II). Upon receiving a command either from the ATCT or the master controller (3.2.5.1), the sequenced flasher light units shall produce a flashing light signal having the appearance of a flash traveling down the ALS from the flasher farthest from the runway threshold to the flasher closest to the runway threshold twice a second. The flasher light units master controller shall be capable of monitoring the status of the flasher light units, and reporting data on flashers performance to the control tower via the substation control and monitor assembly (3.2.4.1). The flasher master controller shall also be capable of controlling the intensity of the flasher light units. All lights shall be designed to operate at three intensity positions, in conjunction with the steady burning light portion of the system as described in 3.2.5.1.3. All intensity step changing of the flasher light units shall be done with the system operating. Complete instructions on accomplishing this change shall be included in the equipment instruction book. When necessary, in order to effectively switch flash capacitors, the master controller may automatically interrupt power to the flasher light units for a period not to exceed 1.5 seconds during intensity step changing. Circuitry shall be provided to prevent simultaneous step changing and triggering. In the event of loss of intensity step control voltage, the flasher light units shall automatically revert to operation on the next lower intensity step. The design shall be such that no erratic arcing or relay operation will occur during any intensity step changing. Components used for intensity step changing shall be designed for a minimum life of 100,000 step changing operations.

3.2.5.1 Flasher master controller unit.- The flasher master controller unit will be located in the substation shelter. It shall provide control signals and conditioned power to the flasher assemblies used in the ALSF-2/SSALR system. It shall also be capable of:

(a) Monitoring the operation of the flasher.

(b) Controlling the intensity of the flasher.

(c) Conveying status signals to the remote panel in the ATCT via the substation control and monitor subsystem.

(d) Switching between the ALSF-2 and SSALR modes.

(e) Providing lightning protection for the output circuits.

3.2.5.1.1 Intensity control resistor cabinet.- If necessary, a resistor cabinet external to the master controller unit shall be

provided with the required resistors, for adjusting the line current in high, medium, and low intensities.

3.2.5.1.2 Power.- Input power shall enter the flasher master controller through an entrance switch and shall be 120/240 V, 60 hertz, 3 wire, single phase. Maximum current on the power line shall not exceed 100 amperes peak. The flasher master controller shall load equally the positive and negative half cycles of the 60 hertz input power line. Unbalanced loading of positive or negative half cycles for half wave current by the flasher assemblies is not permitted. Only full wave current loading is permitted.

3.2.5.1.3 Control.- The flasher master controller shall be controlled either by an integral local control panel or a remote control panel. The local control panel shall have the local/remote control switch in addition to other required controls. The three intensity levels of the flasher light units shall be controlled by the brightness level of the steady burning lights. In brightness levels 1 and 2, the intensity of the flasher light units shall be low. In brightness level 3, the flasher intensity shall be medium, and in brightness levels 4 and 5, the flasher intensity shall be high. Power and control the flasher master controller unit shall be as follows:

ALSF-2/SSALR control	(Logic 1 = ALSF-2)
High intensity	(Logic 1 = high intensity)
Medium intensity	(Logic 1 = medium intensity)
Low intensity	(Logic 1 = low intensity)
Approach System on/off	(Logic 1 = Fault)

Power and control signals from the master controller unit to the control and monitor assembly shall be as follows:

ALSF-2/SSALR indication	(Logic 1 = ALSF-2)
Local/remote indication	(Logic 1 = Local)
High intensity	(Logic 1 = High intensity)
Medium intensity	(Logic 1 = Medium intensity)
Low intensity	(Logic 1 = Low intensity)
On/off	(Logic 1 = On)
Caution	(Logic 1 = Caution)
Fault	(Logic 1 = Fault)

The flasher master controller shall supply power to the flasher assemblies via a 120/240 V, full sine wave 60 hertz line supplying no more than 53 amperes (rms) 75 amperes (peak). In addition, the flasher master controller shall also receive monitoring signals from the individual control cabinet to determine the number of flasher light units that fail to flash.

3.2.5.1.4 Master controller timing requirements.- The conditioned power and the control signals from the master controller to the flasher assemblies shall be in accordance with the following:

ALSF-2 Mode- All flashers shall be active so that the sequence will begin with the flasher farthest from the threshold and proceed toward the flasher closest to the runway threshold. Each flasher shall flash twice per second (±2.5 percent)), in sequence. The time interval between flashes of a single sequence shall be 16.67 milliseconds (±2.5 percent).

SSALR Mode- Alternate flashers shall be active so that the sequence will begin with the flasher farthest from the runway threshold and proceed toward the flasher closest to the runway threshold. Each alternate flasher shall flash twice per second (±2.5 percent), in sequence. The time interval between flashes of a single sequence shall be 33.33 milliseconds (±2.5 percent).

3.2.5.1.5 Monitoring functions.- In addition to the remote operation as previously described, the flasher master controller shall be operable from an integral local control panel. The panel shall contain, as a minimum, the following controls and indicators:

THIS PAGE INTENTIONALLY LEFT BLANK

(a) Local/remote selector switch/indicator

(b) ALSF-2/SSALR selector switch/indicator

(c) Intensity low, medium, and high selector switch/indicator

(d) On/Off selector switch/indicator

(e) Caution indicator

(f) Fault indicator

(g) Individual flasher light unit fault indicators

(h) Necessary switches and indicators to interrogate status registers and input data to isolate problems and determine system operability.

(i) Reset pushbutton switch (monitor)

3.2.5.1.6 Local control panel monitor capability.- By use of the local control panel, maintenance personnel shall be able to observe mode selected, assume control of the system via the local/remote switch, and command and monitor system operation. Each flasher light unit shall be monitored for misfires accumulated over a 100-sample interval. When the thumbwheel set misfire threshold is exceeded, the flasher light unit shall be considered failed and its corresponding failure indication shall be illuminated. To accomplish this, the system monitoring capability shall have the capability to detect a misfire condition and to accumulate the number of misfires during a 100-trigger sample period. No additional wiring to the flash units shall be required for this function. The data shall be compared to a threshold value set in by thumbwheel switches on the local control panel. The thumbwheel switches shall allow the threshold to be varied, in integer numbers, from 1 to 7. When one unit misfires the selected number of times, this shall be registered as one unit out for monitoring purposes. Once the threshold value has been exceeded and the flasher unit failure flag has been set, it shall not be reset until the reset pushbutton has been depressed or recycling of the system on/off select switch has been performed. The monitor signals from the flasher individual control cabinets shall also be routed to the system failure logic for determination of the caution/fault indicator status.

3.2.5.1.7 Remote panel monitoring capability.- Circuitry shall be provided to monitor the operational condition of the flasher system and to provide both an indication of impending failure (caution) and an indication of total fault (failure) to the remote control panel in the ATCT via the control and monitor subsystem. The initial fault detection criteria are outlined below for both the ALSF-2 and SSALR modes of operation.

	CAUTION	FAILURE
SSALR	Any one unit out. More than one intensity present.	Any two units out.
ALSF-2	Any two units out. More than one intensity level present.	Any two consecutive units out. Any three nonconsecutive units out.

Two output signals shall be provided for use at the control and monitor subsystem. One of these signals shall indicate caution and the other shall indicate failure. Both signals shall have a 24 V dc high logic level in a fault state.

3.2.5.1.8 Lightning protection.- Lightning arresters shall be installed between each terminal of the output to ground to protect the output circuits of the master controller from lightning.

3.2.5.1.9 Elapsed time indicator.- An elapsed time indicator shall be installed in the master control cabinet to indicate the number of hours of operation during the high-intensity setting. The indicator shall operate on 120 V, 60 Hz power and shall have an indication to 99,999.9 hours. The total time on the indicator shall be retained after loss of power.

3.2.5.2 Flasher assemblies general requirements.- A flasher assembly shall consist of an individual control cabinet and a flasher light unit. Flasher assemblies shall be classified as follows:

(a) Elevated assembly (Type I)

(b) Semiflush assembly (Type II)

Each type of flasher assembly shall be controlled by a flasher master controller (3.2.5.1) located in the substation shelter (3.2.8.6).

3.2.5.2.1 Individual control cabinet.- The triggering circuit of each flasher light unit shall be located in the individual control cabinet. The trigger transformer may be located in the flasher light unit. The flasher units shall operate satisfactorily when located up to 200 feet (60.96 meters) from the individual control cabinet. The design of the triggering circuits shall be such that failure of one or more flasher light units will not affect operation of the remaining units. Components used in the triggering circuit shall be designed for a minimum life of 50 million flasher operations. The individual

control cabinet shall be equipped with a socket that will receive the flasher tester plug (3.2.5.5). The power transformer shall be placed with high voltage terminals toward the cabinet wall. A high voltage warning label shall be placed on the transformer. The high voltage terminals shall be insulated. The unused terminals on the high voltage capacitors shall be insulated. All high voltage terminals shall have a protective shield to prevent electrical shock hazards. Printed circuit boards and associated components shall be designed so that no arcing will occur.

3.2.5.2.1.1 Input power.- The flasher assembly shall consume not more than 550 watts at 240 V ac when measured with a watt-hour meter or thermal meter giving a steady needle deflection. The assembly shall be capable of operating from an ungrounded 240 V ac source. The assembly shall be designed to operate reliably with a power input range of 210 to 250 V ac.

3.2.5.2.1.2 Input switch and fuse.- Input power shall be controlled by a 250 V ac, double pole, single throw (DPST) toggle switch. The toggle switch shall be in accordance with MIL-S-83731. Circuit overload protection shall be accomplished by a suitably rated type 3AG fuse mounted in a fuse extractor post. The switch and fuse shall be located in the upper right quadrant of the cabinet.

THIS PAGE INTENTIONALLY LEFT BLANK

3.2.5.3.1.2 Flash tube.- The flash tube shall be a plug-in type with a rated life of at least 1,000 hours when operated on the high intensity step. The effective intensity shall not decrease more than 30 percent during the minimum rated life and flash skipping (misfirings) shall be less than 1 percent with no skips occurring consecutively. If the flash tube used is the type which is enclosed in a PAR-56 bulb, then the window, reflector, and socket (3.2.5.3.1.3 through 3.2.5.3.1.5) are not required.

3.2.5.3.1.3 Window.- The flasher light unit shall have a glass window installed to permit the maximum amount of light transmission from the lamp and reflector. The glass shall be aviation white per MIL-C-25050 (ASG) and shall be Class A per MIL-C-7989. It shall be entirely free of bubbles, mold marks, or other imperfections, which might impair light transmission. The glass shall be 1/4 inch (6.35 mm) nominal thickness and shall be highly resistant to mechanical impact and abrasion. The gasket surface of all glass shall be either ground or molder to a sufficiently true surface to ensure a tight joint. The window shall be attached to the lamp housing by watertight gaskets made of material specified in 3.4.8.1 and mounted in such a manner that it can be easily removed or replaced.

3.2.5.3.1.4 Reflector.- A high quality metal reflector with long life reflective surface shall be enclosed in the lamp housing and shall be capable of providing the light output specified in table IX. The reflector shall have a minimum diameter of 7 inches (18 cm).

3.2.5.3.1.5 Socket.- The lamp socket shall be a plug-in type porcelain socket able to withstand the operating temperature of the flasher lamp. Insulating materials used in the socket shall be nonporous and nonabsorbent. Screw terminals shall be provided on the socket for required wire terminations. The socket shall be attached to the lamp housing with two or more screws in a manner facilitating easy removal or replacement of the socket. The socket receptacle of each lamp pin shall make surface connection on more than 180 degrees of the pin surface.

3.2.5.3.1.6 Mounting attachments.- Each flasher light unit shall be assembled to a mounting base. The mounting base shall have an internal wireway to accommodate the six wires mentioned in 3.2.5.2.1.3. The lampholder/mounting base interface shall permit passage of six wires regardless of the lampholder's vertical adjustment angle. The mounting base shall permit rigid mounting of the complete lampholder assembly in either of the following ways:

(a) Capping the open top of a frangible coupling (FAA Drawing C-6046) or a 2 inch (5.08 cm) electrical metallic tubing (emt) conduit (FAA Drawing D-6238-15). Three equally spaced (120 degrees) 3/8-inch (0.95 cm round head stainless steel screws (with slightly cupped tips) shall be provided for this method of attachment.

(b) Mounting into a lamp support as shown on FAA-Drawing D-6238-15.

3.2.5.3.1.7 Flasher assembly wire.- The flasher assembly design shall be such that all wires between the flasher individual control cabinet and the flasher light unit shall fit through a 1/2-inch (1.27 cm) conduit. All such wire shall be single conductor and a maximum of six wires shall be used between the flasher light unit and flasher individual control cabinet. If wire having an insulation rating greater than 600 volts is required, the contractor shall provide wires (60 feet (18.28 meters) to permit continuous runs from the individual control cabinet to a flasher light unit mounted on top of a 40 foot (12 meter) low impact resistance structure. The flasher light unit shall include a 1/2-inch liquid tight flexible conduit fitting on the bottom of the head through which wires from the flasher individual control cabinet will be routed.

3.2.5.3.1.8 Flasher light unit weight.- The maximum weight of the flasher light unit as defined in 3.2.5.3.1, including the mounting attachments required per 3.2.5.3.1.6, shall be 5 pounds (2.26 kilograms).

3.2.5.3.1.9 Aiming device.- The aiming device shall be designed for use with the flasher light unit and the PAR-56 lampholder. The aiming device shall fit onto the PAR-56 lampholder and flasher light unit without disassembly of the lampholder or removal of the lamp. The aiming device shall permit field aiming of the lamp axis perpendicular to the plane of the cover glass at any angle from 0 degrees to +25 degrees above the horizontal. The aiming device shall be constructed of a light weight non-corrosive metal and weigh no more than three pounds. The device shall have no loose parts, i.e., no pins. The device should have an enclosed dial and stop break to hold the reading. The device shall be capable of remotely measuring the alignment of the light unit when mounted on low impact resistant structures that conform to FAA-E-2604 or FAA-E-2702. The aiming device shall retain its reading when the tower is lowered. With the support structure in the elevated position, the aiming device shall permit an individual to accurately aim the light unit from the ground after lowering the structure a maximum of two times regardless of the tilting direction of the structure. The aiming device shall be capable of aiming the light unit mounted on a frangible coupling (FAA-Drawing C-6046). The aiming angle shall be indicated in 1 degree intervals and shall be accurate to within $\pm$ 1/2 degree of the actual aiming angle with the aiming device attached. If a digital display is used the indication shall be in degrees and in tenths of a degree of angle. The final aimed angle of the light unit with the aiming device unattached shall be accurate within 1 degree of the actual angle. The aiming device shall be designed to operate in any ambient

temperatures between -55 degrees Centigrade (C) (-67 degrees Fahrenheit (F) and +70 degrees C (158 degrees F).

3.2.5.4 Semiflush flasher assembly (Type II).- The semiflush flasher assembly shall consist of an individual control cabinet (3.2.5.2.1) and a flasher light unit. The flasher light unit shall be designed for installation in paved areas and shall be capable of withstanding roll-over by aircraft without damage.

3.2.5.4.1 Semiflush light unit.- The semiflush light unit shall be designed for mounting on Type LB-4 bases, as specified in FAA-E-1315. Accessories for the light unit, excluding the light unit top assembly, shall be in accordance with FAA-E-2491. Electrical input shall be as specified in 3.2.5.2.1.3. An L-823 connector shall be used to connect the input cable to the flasher light unit (FAA Drawing D-6238-6).

3.2.5.4.1.1 Semiflush light unit top assembly.- The top assembly shall be fabricated from high strength metal which is inherently corrosion resistant. The top surface shall have a Brinell hardness of not less than 180, and shall be smoothhand free of sharp projections. If not inherently corrosion-proof, the materials used shall be treated for effective, long-lasting corrosion resistance. Painting alone will not be considered a sufficient protective coating. Designs employing glass overall or a substantial portion of the top surface will not be accepted. The design shall permit pressure from tires, mechanical impact, thermal shock, and vibration without damage or loss of water tight seal. The top assembly shall be the minimum, size and weight consistent with good design and shall be in compliance with requirements of this description. It shall not have more than 400 square inches (0.25 square meter) of exposed area above the surface of pavement. The maximum lateral dimension of the top shall be no more than 26 inches (66 cm). No portion of the top assembly shall project more than 1 inch (2.54 cm) above pavement. The design shall provide for the outer edges of the top assembly to be flush with the pavement and provided with a watertight seal capable of withstanding an internal or external pressure of 10 pounds per square inch (psi). If the entire optical system is in a sealed module, this watertight requirement applies only to the module. The maximum temperature of the top assembly shall not be greater than 150 degrees C (302 degrees F) after an aircraft tire had been on the fixture for 10 minutes. The top surface shall have an average slope not exceeding 10 degrees in a direction parallel to beam axis, and not more than 12 degrees transverse to beam axis except for the light window and the sides of the light exit channel. All bolts in the top surface shall be recessed to the full depth of the head and shall permit the use of a standard thin wall socket wrench. The top assembly shall be held to the type LB-4 base with six bolts.

THIS PAGE INTENTIONALLY LEFT BLANK

The bolts shall be fabricated from stainless steel (3.5.2.2.2). A means for breaking the seal and lifting the top assembly shall be provided. If the optical system is attached to the top assembly, the optics protective devise shall serve as a strand for the light unit when removed from its base.

3.2.5.4.2 Intensity of the semiflush light unit.- The inpavement flasher light unit shall produce the intensities shown in table X.

Table X. Light Intensities (Type II)

Intensity Setting	Maximum Allowable Effective Intensity (candelas)	Minimum Effective Intensity (candelas)
High	20,000	5,000
Medium	2,000	500
Low	600	150

The effective intensity measurements shall be made over a rectangular pattern not less than 10 degrees vertically and 30 degrees horizontally. The geometric center of this 10 degree by 30 degree pattern shall be 7 degrees ±1/2 degree above the horizontal. Corners may be rounded on a 5 degree radius to determine compliance with values in table X.

3.2.5.4.3 Static loading.- The light, when installed in a light base, shall be able to support the static loads of 4.4.9.2.

3.2.5.4.4 Window loading.- The window shall be able to support a load equal to 500 psi multiplied by the area of the opening.

3.2.5.5 Flasher Tester.- The flasher tester shall test the individual control cabinet and its associated flasher light unit. It shall isolate failures to the LRU level. It shall measure certified, key performance parameters and other critical electrical values and flag any that are out of tolerance.

3.2.5.5.1 Physical characteristics.- The tester shall be a single portable unit not weighing more than 10 pounds. A single cable and plug shall connect the flasher tester to the individual

control cabinet test socket (3.2.5.2.1). Indicators shall be readable in broad daylight and at night. Linear electrical data and out of tolerance values shall be displayed in engineering units. LRU information, lamp life data, etc. shall be displayed in English language formats without the use of special codes or look-up tables. The tester shall be powered by nickel cadmium batteries. A battery charger shall be provided that permits battery charging without removing the batteries from the tester.

3.2.5.5.2 Electrical measurements.- As a minimum, the following 3 items shall be measured for normal and out of tolerance values:

a. input voltage, current and power
b. input control signals including timing criteria
c. triggering circuits including current and voltage magnitudes
d. output electrical values to the flasher light unit
e. flasher rate

3.2.5.5.3 Operation.- The flasher shall be highly automated with no more than two operator actions to perform any tests. The LRU fault isolation shall be a single test. The tester shall isolate, to the LRU level, 97% of all individual component failures (shorts or opens).

3.2.5.5.4 Tester instructions.- Two type of instructions shall be provided, a portable set and detailed set.

3.2.5.5.4.1 Portable instructions.- Shall provide a simple description of how each function is selected and simple results. It shall be in a portable format housed inside tester. These instructions shall be plasticize for weather resistance.

3.2.5.5.4.2 Flasher tester instruction book.- The flasher tester instruction book shall be in-depth showing details of each operation, theory of operation, maintenance requirements and repair instruction. It shall be provided in accordance with FAA-D-2494.

3.2.6 Elevated PAR-56 lampholders.- Elevated PAR-56 lampholder shall support PAR-56 lamps and allow for angular adjustment. They interface mechanically to a supporting structure and electrically to the isolation transformers. Elevated PAR-56 lampholders shall be in accordance with FAA-E-982.

3.2.6.1 Aiming device for the PAR-56 lampholder.- The aiming device for PAR-56 lampholders shall be in accordance with 3.2.5.3.1.9.

3.2.7 Site spare parts.- Each unit of equipment (3.1.1(a) through (i)) shall include one spare printed circuit board assembly of each type used in each equipment, complete with all components, tested and operable. The material used to wrap or package spare parts shall be static free.

3.2.8 Equipment required but not furnished.- The following items are not furnished under this contract but are required to make a complete approach lighting system.

3.2.8.1 Isolation transformers.- Isolation transformers isolate each lamp from the high voltage constant current loop and maintain loop integrity in the event of lamp failure. Transformers used will be in accordance with FAA Advisory Circular AC 150/5345-47, type L830-9 and L830-13, respectively. The 1500 watt transformers will be in accordance with FAA-E-2690.

3.2.8.2 PAR-56 lamps.- The lamps used in the ALS (steady burning) are of quartz halogen type and will be size PAR-56. Light output and beam shape will be in accordance with FAA-E-2408 for both the 300 watt and 500 watt lamps. Three hundred watt lamps are used for white illumination and 500 watt lamps are used in colored application (red or green). Both lamps require 20 amperes to produce full intensity.

3.2.8.3 Flasher subsystem transformer.- The transformer converts 2,400 V, 60 Hz, one phase power from the high voltage input cabinet to provide 120/240 V, ± 10 percent, 60 hertz, potential input power to the master controller. The transformer will have the following characteristics: 25 kilovoltamperes (KVA) (maximum), one phase, 2,400-120/240 V, dry type with taps.

3.2.8.4 Utility transformer.- The utility transformer receives 2,400 V, 60Hz, one phase power from the high voltage input cabinet, and provides input power (120/240 V, ± 10 percent, 60 hertz) to the electrical and mechanical equipments in the substation shelter. The transformer will have the following characteristics: 25 KVA, one phase, 2,400-120/240 v.

3.2.8.5 Low impact resistance structures.- Low impact resistance (LIR) structures will be used to support the approach lighting system lighting fixtures. Low impact resistance structure shall be in accordance with FAA-E-2702.

3.2.8.6 Shelter.- The substation shelter provides environmental protection, work shop space, and storage for tools and spare parts. A typical shelter is shown on FAA Drawings D-6238-17 and D-6238-18.

THIS PAGE INTENTIONALLY LEFT BLANK

3.2.8.7 Semiflush fixtures.- Semiflush fixtures used for the inpavement ALS lights are in accordance with FAA-E-2491.

3.2.9 Remote monitoring subsystem (RMS).- A remote monitoring subsystem shall be supplied with the system and shall:

(a) provide lightning protection for the input AC power and data transmission link.

(b) contain sensors required for acquiring the data identified in paragraph 3.2.10 through 3.2.10.5.6.

(c) contain a versatile module eurocard (VME) backplane bus interface card cage containing all circuitry necessary to (1) accomplish management of the data link, (2) meet the modem requirements, (3) format equipment parameters, (4) transmit data at the proper times to the MPS, and (5) meet all input/output requirements.

(d) provide interfaces for the maintenance processor subsystem (MPS) and maintenance data terminal (MDT).

(e) provide the capability to monitor, control, and diagnose ALSF-2/SSALR equipment.

(f) contain initialization and self-testing capability.

3.2.9.1 General RMS requirements.- The ALSF-2/SSALR RMS shall include voltage and current sensors, cabling, connectors, and mounting hardware necessary to route required signals and control functions to the monitoring units of the ALSF-2/SSALR RMS, and shall include all circuitry necessary to buffer, condition data into engineering units, and preprocess sampled signals. The RMS shall transmit the data to the MPS in accordance with the formats and requirements of NAS-MD-790A and shall execute control commands sent by the MPS and MDT.

3.2.9.1.1 MDT interface.- The ALSF-2/SSALR RMS shall be provided with a terminal interface as described in NAS-IR-51045100. The interface shall be wired to a front panel mounted female MIL-C-24308 (MS-18275) connector.

3.2.9.1.2 MPS interface.- The ALSF-2/SSALR RMS shall be provided with an MPS interface in accordance with NAS-MD-790A.

3.2.9.1.2.1 Protocol.- The protocol used to control the MPS data interface shall be in accordance with ANSI X3.66 as specified in NAS-MD-790A.

3.2.9.1.3 VME bus interface system.- The RMS equipment shall utilize printed wiring boards meeting all electrical and mechanical specifications contained in IEEE-P1014 for all RMS circuitry. The card cage and backplane shall be capable of accommodating the future addition of at least three VME double-height boards, physical configuration option NECP, without further modification. Backplane connectors provided for the purpose of accommodating the future addition of VME boards shall have user I/O pin assignments brought to individual solder terminals or connectors suitable for the future addition of wires.

3.2.9.1.4 Memory.- Memory shall consist of the appropriate combinations of read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), logic arrays, and random-access memory (RAM). The basic PROM or EPROM device shall be available to the Government as a commercially available off-the-shelf item. The RMS shall have expansion capabilities as required by paragraph 3.2.9.1.5. and 3.4.14.6. Memory expansion techniques, i.e., hardware, firmware, or software changes shall be addressed in the equipment instruction book (see Paragraph 3.7).

3.2.9.1.4.1 Volatility.- Storage of all control settings, operational parameters and limits, all initialization data, all data files and fault history shall be supported with sufficient battery capacity or other techniques to ensure the non-volatility of stored data for a period of not less than ninety days. Fault history shall include the last routine parameter data and the post-fault (prior to alarm) parameter data for the last ten system faults.

3.2.9.1.5 RMS expansion.- In addition to all other requirements specified herein, the ALSF-2/SSALR RMS shall have, as a minimum, 20 spare analog input, 15 spare digital input, and 10 spare digital output lines. The capability for utilizing these input and output lines shall not be implemented; however, the original hardware, firmware, and software shall be designed for future

utilization of these lines with minimal modification. The analog input shall be a differential input and shall enable the RMS to provide a digital output signal representing the input value. A signal comparator having two (2) sets of adjustable thresholds, one (1) for alarms and one (1) for alerts, shall be provided. These thresholds shall be programmable in 100 millivolt steps throughout the range of the voltage input. The RMS shall not introduce or cause an error in the true analog reading in excess of ±0.1 volt. The input impedance of the analog input shall be greater than one megohm.

3.2.9.1.6 Test points.- The RMS equipment design shall incorporate indicators, warning signals, test jacks, and test points to facilitate troubleshooting and malfunction isolation. Test points shall be provided to check critical timing waveforms, power supply output voltages, and for the injection of test signals. The test points shall be located for easy accessibility. Their locations shall be kept to a minimum, and each shall be labeled for easy identification and reference to maintenance data, and shall be designed for easy attachment of test probes and test equipment.

3.2.9.1.7 Indicator lights.- Indicator light(s) shall be provided on the cabinet front panel to indicate application of power.

3.2.9.1.8 Reset switch.- Each unit employing microprocessors shall have a front panel mounted, momentary contact switch labeled "reset". Activation of the reset switch shall cause all program variables and all software/firmware controlled hardware to be initialized to a predefined condition from which normal program execution can continue. The MPS shall be notified of a change of state in accordance with NAS-MD-790A.

3.2.9.1.9 Environmental sensors.- The following sensors together with all necessary cabling, connectors, terminal boards, enclosures, mounting hardware, and installation and maintenance instructions shall be provided with each ALSF-2/SSALR equipment as specified below. Measurements from the sensors shall be processed by the RMS for transmission to the MPS at appropriate times and for output locally via the MDT interface.

(a) Intrusion detector (2 each)
(b) Smoke detector (2 each)
(c) AC power
(d) E/G power
(e) Inside temperature (2 each)
(f) Outside temperature

These sensors shall meet the requirements of paragraphs 3.2.10.5 through 3.2.10.5.6.

3.2.9.1.10 Data communications failures.- When data communication failures between the RMS and the MPS occur, the retry and continuous polling procedures of paragraph 3.8 of NAS-MD-790A shall be implemented. Additionally, the ALSF-2/SSALR RMS shall have at least one (1) megabyte of storage for automatic storage of all ALSF-2/SSALR equipment data during communications failures.

3.2.10 RMS performance parameter monitoring requirements.- The following performance parameters shall be monitored. The availability and use of these parameters shall be accomplished without interruption to normal operation.

3.2.10.1 System status parameters.- As a minimum, the status of the following ALSF-2/SSALR and environmental parameters shall be monitored: All the ALSF-2/SSALR monitored parameters of table Xa, and all system input voltages and currents, all cabinet, regulator, subsystem input and output voltages and currents, and all power supply input and output voltages and currents. See paragraph 3.4.15.3.2.2.

3.2.10.1.1 Sensors.- Sensors (transducers) and signal conditioning equipment shall be provided to allow the monitoring subsystem to reliably detect lamp or lamp bar malfunctions and compute the caution and failure signals required by table VI in 3.2.4.5.2.

3.2.10.2 Key equipment performance parameters.- ALSF-2/SSALR and associated equipment key performance parameters (also referred to as standards and tolerances) shall be available for automatic monitoring at the MPS interface and demand monitoring at both the MPS and MDT interfaces. These parameters are identified in table VI. Soft alarm (alert/caution) and hard alarm (failure) processing shall meet the requirements of paragraphs 3.2.4.5 and 3.2.5.1.7.

3.2.10.3 ALSF-2/SSALR certification parameters.- The certification parameters as indicated in table Xb shall be available for automatic monitoring at the MPS interface and demand monitoring at both the MPS and MDT interfaces.

3.2.10.4 ALSF-2/SSALR key performance checks.- Performance checks (or equivalent measurements) required for the ALSF-2/SSALR in the instruction book (see paragraph 3.7.1) shall be available for demand monitoring at the MPS and MDT interfaces.

TABLE Xa. ALSF-2/SSALR Monitored Parameters

Parameter	Normal	Alert (Soft Alarm)	Alarm
Software version	Software version number	N/A	N/A
Date/Time	Date/Time	N/A	N/A
ALSF-2/SSALR system status	All monitored parameters normal	One or more monitored parameters in Alert condition and no monitored parameters in alarm condition.	One or more monitored parameters in alarm condition.
System operating mode	ALSF-2/SSALR	N/A	N/A
System control mode	ATCT/Maintenance	N/A	N/A
ALSF-2 steady burning lights			
a. Loop 1	All lamps on	5 lamps out	6 or more lamps out
b. Loop 2	All lamps on	5 lamps out	6 or more lamps out
c. Loop 3	All lamps on	5 lamps out	6 or more lamps out

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
ALSF-2 flashers Flashers out (random)	All flashers operating	2 flashers out (random)	2 or more flashers out (consecutive); 3 or more
SSALR steady burning lights			
a. Loop 1	All lamps on	2 lamps out	3 or more lamps out
b. Loop 2	All lamps on	2 lamps out	3 or more lamps out
c. Loop 3	All lamps on	2 lamps out	3 or more lamps out
SSALR flashers	All flashers operating	1 flasher out	2 or more flashers out
ALSF-2			
a. Centerline bars			
1. Centerline bar	All lamps on	2 lamps out in a 5-lamp bar[1]	3 or more lamps out in a 5-lamp bar[1]

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
2. Centerline bars, inner 1500-feet	All lamps on	2 consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 15 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	3 or more consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 20 percent of lamps out (random)[1]
3. Centerline bars, outer	All lamps on	2 consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 15 percent lamps out (random) and less than or equal to 20 percent lamps out (random)	3 or more consecutive light bars out (3 or more lamps out in a 5-lamp bar); more than 20 percent of lamps out (random)[1]
b. Side row bar	All lamps on	1 lamp out in a 3-lamp bar[1]	2 or more lamps out in a 3-lamp bar[1]

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
c. Side row bars	All lamps on	2 consecutive light bars out; more than 15 percent lamps out (random) and less than or equal to 20 percent lamps out (random)[1]	3 or more consecutive light bars out; more than 20 percent of lamps out (random)
d. Threshold bar	All lamps on	3 adjacent lamps out; more than 15 percent lamps out (random) and less than or equal to 20 percent lamps out (random)[2]	4 or more adjacent lamps out; more than 20 percent of lamps out (random)[2]
e. 500-foot bar		3 adjacent lamps out; more than 15 percent lamps out (random) and less than or equal to 20 percent lamps out (random)[2]	4 or more adjacent lamps out; more than 20 percent of lamps out (random)[2]
f. 1,000-foot bar		3 adjacent lamps out; more than 15 percent lamps out (random) and less than or equal to 20 percent lamps out (random)[2]	4 or more adjacent lamps out; more than 20 percent of lamps out (random)[2]

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
Flasher flash rate	120 ±2 flashes per minute		More than 122 flashes per minute; less than 118 flashes per minute
Power source	Commercial/ Engine generator	N/A	N/A
Power source voltages			
a. Commercial	Specified ac line voltage	Specified ac line voltage ±5.1 percent to ±10 percent	Specified ac line voltage ±10.1 percent or more
1. Voltage			
(a) Phase A	Measured voltage	N/A	N/A
(b) Phase B	Measured voltage	N/A	N/A
(c) Phase C	Measured voltage	N/A	N/A
2. Current			
(a) Phase A	Measured amperage	N/A	N/A
(b) Phase B	Measured amperage	N/A	N/A
(c) Phase C	Measured amperage	N/A	N/A

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
b. Generator	Specified ac line voltage	Specified ac line voltage ±5.1 percent to ±10 percent	Specified ac line voltage ±10.1 percent or more
1. Voltage			
(a) Phase A	Measured voltage	N/A	N/A
(b) Phase B	Measured voltage	N/A	N/A
(c) Phase C	Measured voltage	N/A	N/A
2. Current			
(a) Phase A	Measured amperage	N/A	N/A
(b) Phase B	Measured amperage	N/A	N/A
(c) Phase C	Measured amperage	N/A	N/A
High voltage input cabinet input power			
a. Voltage			
1. Phase A	Specified voltage	Specified voltage ± X percent	Specified voltage ± X percent
2. Phase B	Specified voltage	Specified voltage ± X percent	Specified voltage ± X percent

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
3. Phase C	Specified voltage	Specified voltage ± X percent	Specified voltage ± X percent
b. Current			
1. Phase A	Measured amperage	N/A	N/A
2. Phase B	Measured amperage	N/A	N/A
3. Phase C	Measured amperage	N/A	N/A
Steady burning lights			
a. Loop current			
1. Loop 1	Specified loop current	Specified loop current ± X percent	Specified loop current ± X percent
2. Loop 2	Specified loop current	Specified loop current ± X percent	Specified loop current ± X percent
3. Loop 3	Specified loop current	Specified loop current ± X percent	Specified loop current ± X percent

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
b. Loop voltage			
1. Loop 1	Specified voltage	N/A	Over voltage; under voltage
2. Loop 2	Specified voltage	N/A	Over voltage; under voltage
3. Loop 3	Specified voltage	N/A	Over voltage; under voltage
Flasher status	On/off	N/A	N/A
Flasher intensity	Low/Medium/High	N/A	N/A
Steady burning light status	On/off	N/A	N/A
Steady burning light intensity	Brightness 1/2/3/4/5	N/A	N/A
Power supply inputs[3]			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured amperage	N/A	N/A
2. ac current	Measured amperage	N/A	N/A
Power supply outputs[3]			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured amperage	N/A	Over current
2. ac current	Measured amperage	N/A	Over current
Cabinet inputs[3]			
a. Voltage			

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured amperage	N/A	Over current
2. ac current	Measured amperage	N/A	Over current
Cabinet outputs[3]			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured amperage	N/A	Over current
2. ac current	Measured amperage	N/A	Over current

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
Subsystem inputs[3]			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
b. Current			
1. dc current	Measured amperage	N/A	Over current
2. ac current	Measured amperage	N/A	Over current
Subsystem outputs[3]			
a. Voltage			
1. dc voltage	Specified dc voltage	Specified dc voltage ± X percent	Specified dc voltage ± X percent
2. ac voltage	Specified ac voltage	Specified ac voltage ± X percent	Specified ac voltage ± X percent
a. Current			

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
1. dc current	Measured amperage	N/A	Over current
2. ac current	Measured amperage	N/A	Over current
ATCT/Substation communications			
a. Receive carrier	Carrier	N/A	No carrier
b. Transmit carrier	Carrier	N/A	No carrier
c. Error detection	No errors detected		Errors detected
RMS CPU Status	Pass		Fail
RMS control mode	MDT/MPS	N/A	N/A
Intrusion	No		Door open for more than 0.25 seconds and MDT not connected within 5 minutes.
Smoke detector			
a. Equipment shelter	Not Activated		Activated

TABLE Xa. ALSF-2/SSALR Monitored Parameters (Continued)

Parameter	Normal	Alert (Soft Alarm)	Alarm
b. Engine generator shelter	Not activated		Activated
Inside temperature	30° C nominal	XXX° C	70° C
Outside temperature	XXX° C	N/A	N/A

[1] Diagnostics display shall identify each light bar that has failed.
[2] Diagnostics display shall identify each lamp that has failed.
[3] When used, in accordance with paragraph number 3.4.15.3.2.2.

Table Xb. ALSF-2/SSALR Certification Parameters

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
1. Light plane	Light bar lamps illuminated	All lamps on	(value)	Same as standard	Less than 3 consecutive light bars out, 20% or less (random) of lamps out
2. Light intensity	Vertical angular alignment	Locally established vertical angle of lighted beam axis of light All flashers aimed at 6° or as installed	N/A at RMS	Standard ±1°	Standard ±2°
	Horizontal angular alignment	Parallel to centerline of runway	N/A at RMS	Standard ±1°	Standard ±2°
	Regulator output currents				
	step 1	8.5A	(value)	±0.2A	±0.2A
	step 2	10.3A	(value)	±0.3A	±0.3A
	step 3	12.4A	(value)	±0.3A	±0.3A
	step 4	15.8A	(value)	±0.4A	±0.4A
	step 5	20.0A	(value)	+0.0A, -0.4A	+0.0A, -0.4A

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
3. Brightness control capability	Brightness step changing time:				
	Change time from step 1 to step 2 (from initial turn on)	See instruction book	(value)	Same as standard	Same as standard
	Change time between steps (after initial turn on)	No delay	(value)	Same as standard	Same as standard
4. Identify threshold	ALSF-2				
	Threshold bar	All lamps on	(value)	Same as standard	Less than 4 adjacent lamps out, 20% or less (random) of lamps out
	Green filters	All in place	Filter status N/A at RMS	Same as standard	Same as standard
	SSALR				
	Threshold bar	All lamps on	(value)	Same as standard	Less than 4 lamps out
	Green filters	All in place	Filter status N/A at RMS	Same as standard	Same as standard

FAA-E-2689a
NOTICE-3
December 9, 1992

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

	Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
5.	Identify 500 feet from threshold	500-foot bar	All lamps on	(value)	Same as standard	Less than 4 adjacent lamps out, 20% or less (random) of lamps out
6.	Identify area from threshold to 1000 foot bar	Side-row bar	All lamps on	(value)	Same as standard	Less than 2 lamps out in 3-lamp bar, or less than 3
		Red filters	All in place	Filter status N/A at RMS	Same as standard	Same as standard
7.	Identify 1000 feet from threshold	1000-foot bar	All lamps on	(value)	Same as standard	Less than 4 adjacent lamps out, 20% or less (random) of lamps out Less than 4 lamps out
8.	Identify approach path	Sequenced flashing lights operation ALSF-2	All lamps on	(value)	Same as standard	Less than 2 consecutive or 3 random lamps out

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
8. Identify approach path (cont'd)	Sequenced flashing lights operation SSALR	All lamps on	(value)	Same as standard	Less than 2 lamps out
	Flashing rate	120 per minute	(value)	±2 per minute	Same as standard
9. Visibility	Obstructions	No obstruction	N/A at RMS	Same as standard	Same as standard

Table Xb. ALSF-2/SSALR Certification Parameters (Continued)

Service	Certification Parameters	Standard	Actual	Initial Tolerance	Operating Tolerance
10 Monitoring	ALSF-2				
	Incandescent light operation	CAUTION-5 lamps out per loop	(value)	Same as standard	Same as standard
		FAILURE-6 lamps out per loop	(value)	Same as standard	Same as standard
	Flasher operation	CAUTION-2 random units out	(value)	Same as standard	Same as standard
		FAILURE-2 consecutive units out	(value)	Same as standard	Same as standard
	SSALR				
	Incandescent light operation	CAUTION-2 lamps out per loop	(value)	Same as standard	Same as standard
		FAILURE-3 lamps out per loop	(value)	Same as standard	Same as standard
	Flasher operation	CAUTION-1 unit out	(value)	Same as standard	Same as standard
		FAILURE-2 units out	(value)	Same as standard	Same as standard

NORMAL CERTIFICATION INTERVAL: Monthly
MAXIMUM CERTIFICATION INTERVAL: 90 days
PERSON RESPONSIBLE FOR CERTIFICATION: Maintenance person at lighted navigational aid.
CERTIFICATION ENTRY IN FACILITY MAINTENANCE LOG: ALSF-2/SSALR certified.
CERTIFICATION ENTRY (WITH EXCEPTION)
IN FACILITY MAINTENANCE LOG: ALSF-2/SSALR certified except:

1. ALSF-2 Out of Tolerance/Limit
2. Flasher Out of Tolerance/Limit
3. Monitor Out of Tolerance Limit
4. Light Bar (Number) Out of Tolerance/Limit

3.2.10.5.1 Intrusion detector.- The intrusion detector shall detect the opening of the ALSF-2/SSALR equipment shelter door and the ALSF-2/SSALR engine generator shelter door (the doors and shelters are not a part of this specification). The shelter security parameter shall be timed on when the detector senses that the door has been open for 0.25 seconds. A security alarm message shall be provided to the MPS interface if a portable terminal is not connected to the MDT interface within 5 minutes. The shelter security parameter shall return to normal if the MDT is connected to the terminal interface within 5 minutes. If after being connected, the MDT is disconnected from the terminal interface, the RMS shall inhibit sensing a shelter security alarm for a period of 5 minutes prior to resuming normal monitoring of the shelter security parameter. It shall be possible to bypass each of the intrusion detectors separately through commands from the MPS and MDT and manually at the RMS cabinet.

3.2.10.5.2 Smoke detector.- The ALSF-2/SSALR systems shall be furnished with an ionization type smoke detector for the ALSF-2/SSALR equipment shelter and a photoelectric type smoke detector for the engine generator shelter. The ionization type smoke detector shall meet the requirements of and bear the label of Underwriters Laboratories, Inc. Standard 268. The photoelectric type detector shall meet the requirements and bear the label of Underwriters Laboratories, Inc. Standard 217. A smoke detector alarm message shall be provided to the MPS interface upon activation of the smoke detector.

3.2.10.5.3 Commercial ac power.- Each ALSF-2/SSALR system shall be provided with a commercial ac power sensor. The commercial ac power sensor shall detect the presence/absence of specified commercial ac power applied to the ALSF-2/SSALR equipment. The commercial ac power alarm message shall be provided to the MPS interface if the commercial ac power fails.

3.2.10.5.4 Engine generator ac power.- Each ALSF-2/SSALR system shall be provided with an engine generator ac power sensor. The engine generator ac power sensor shall detect the presence of specified engine generator ac power applied to the ALSF-2/SSALR equipment. The engine generator failure alarm message shall be sent to the MPS interface if the engine generator fails to start due to loss of commercial ac power or a start command from the air traffic control tower; or failure of the engine generator after a successful start.

3.2.10.5.5 Inside temperature.- Each ALSF-2/SSALR system shall be furnished with two inside temperature sensors. The temperature sensors shall provide the temperature inside the ALSF-2/SSALR equipment shelter and inside the engine generator shelter (neither of the shelters are a part of this

specification) to the RMS with an accuracy of ± one degree centigrade. The inside temperature shall be available for automatic and demand monitoring at the MPS and MDT interfaces.

3.2.10.5.6 Outside temperature.- Each ALSF-2/SSALR system shall be furnished with an outside temperature sensor. The temperature sensor shall provide the outside temperature to the RMS with an accuracy of ± one degree centigrade. The outside temperature shall be available for automatic and demand monitoring at the MPS and MDT interfaces.

3.3. Physical characteristics.- The enclosures to be supplied under this specification shall be as specified herein.

3.3.1 High voltage input cabinet.- The high voltage input cabinet shall be a NEMA 12 enclosure, 72 inches (1,829 mm) high by 36 inches (914 mm) wide by 24 inches (610 mm) deep. The steel enclosure shall be equipped with a lockable door and with 1/4-inch transparent plexiglass enclosure, or equal, guarding all exposed high voltage terminals. Warning signs shall be installed as specified in 3.4.12. Circuitry and layout for the cabinet shall be in accordance with FAA Drawings D-6328-22 and D-6238-24 through D-6238-29. The high voltage input cabinet shall comply with National Electric Code and National Standards established by the Occupational Safety and Health Act (OSHA). The control wiring terminal board shall be located to the front of the cabinet so that it will not be necessary to enter the high voltage areas to make measurements on the control wiring. The contractor shall furnish preliminary drawings for approval. These drawings shall show the control wiring and terminations.

3.3.2 High voltage output cabinet.- The high voltage output cabinet shall be a NEMA 12 enclosure, 72 inches (1,829 mm) high by 36 inches (914 mm) wide by 24 inches (610 mm) deep. The steel enclosure shall be equipped with a lockable door and with 1/4-inch transparent plexiglass enclosures, or equal, guarding all exposed voltage terminals. Warning signs shall be installed as specified in 3.4.12. Circuitry and layout for the cabinet shall be in accordance with FAA Drawings D-6238-22, D-6238-23, and D-6131-30 through D-6131-37. The high voltage output cabinet shall comply with the National Safety and Health Act (OSHA). The control wiring terminal board shall be located to the front of the cabinet so that it will not be necessary to enter the high voltage areas to make measurements on the control wiring. The contractor shall furnish preliminary drawings for approval. These drawings shall show the control wiring and terminations.

3.3.3 Constant current regulators.- The 50 kilowatt (Kw) current regulators shall be contained in a steel enclosure not to exceed 70 inches high by 40 inches wide by 47 inches deep. The unit

shall be mounted on a steel base plate with feet or channels and shall be a rectangular footprint on 30 inch (762 mm) centers. Lifting eyes shall be provided on all four upper corners. Reactors, capacitors, and indoor transformers shall be provided with a steel enclosure, and they may be insulated or cooled using transformer oil or air. The steel tank shall have a steel control cabinet permanently attached for housing the control electronic circuities. High voltage input terminals shall be enclosed with steel.

3.3.4 Substation control and monitor assembly.- The substation control and monitor assembly is shown in figure 12. The steel cabinet shall be a NEMA Type 12 enclosure. The cabinet shall have a split door with the upper portion being 14 inches (356 mm) high and the lower portion being 22 inches (559 mm) high. The upper door shall serve as the local control panel and the lower door shall provide access to the control and monitor electronic assemblies and interface wiring. Gasketing shall be provided for both doors such that the upper edge of the lower door will seal against the contoured lower edge of the upper door. Opening of the upper door shall not be possible without first opening the lower door, and locking provisions shall be provided on the lower door. The cabinet doors shall open from the right side and a door stop shall be provided to lock the door in a 120 degree open position. The monitor card cage assembly shall also contain the test/adjustment panel as depicted in figure 12.

3.3.5 Remote electronic chassis.- The remote electronic chassis shall be a NEMA Type 12 steel enclosure, 20 inches (508 mm) high by 16 inches (406.4 mm) wide by 10 inches (254 mm) deep. The unit shall be constructed such that it can be either wall mounted (up to 300 feet (91.44 m) from the tower control console) or placed on the floor directly below the console. The unit shall have a gasketed, lockable door, with right-hand opening. The chassis shall interface with the ATCT control panel via a multiconductor cable and with the substation control and monitor assembly via a pair of telephone wires.

3.3.6 Airport traffic control tower (ATCT) control panel.- The ATCT control panel shall be as shown in figure 6, and shall have a metal enclosure with the following dimensions: 9.5 inches (241 mm) wide by 5.25 inches (133 mm) high by 5 inches (127 mm) deep. It shall be supported in the tower console by a lip around the perimeter of the front panel. This lip shall not be less than 0.25 inches (6.3 mm) from the panel edge at any point. Power supplies or electronic circuits shall not be mounted in or on the control panel. Interface to the remote electronic chassis shall be with connectors conforming to MIL-C-26482 and a multiconductor cable.

3.3.7 Flasher master controller cabinet.- The flasher master controller cabinet shall be a NEMA Type 12 enclosure. The cabinet shall have the following maximum dimensions: 30 inches (762 mm) high by 36 inches (914 mm) wide by 12 inches (304.8 mm) deep. It shall have mounting means external to the cabinet cavity, and provision for locking, and shall not have conduits or knockouts. Space shall be provided in the cabinet for all external cable connections.

3.3.8 External resistor cabinet.- If required, the resistor cabinet shall be a waterproof, dust-tight enclosure. The cabinet shall be made of stainless steel or aluminum and shall have the following dimensions: 40 inches (1010 cm) by 20 inches (550 cm) by 13 inches (330 cm) (maximum).

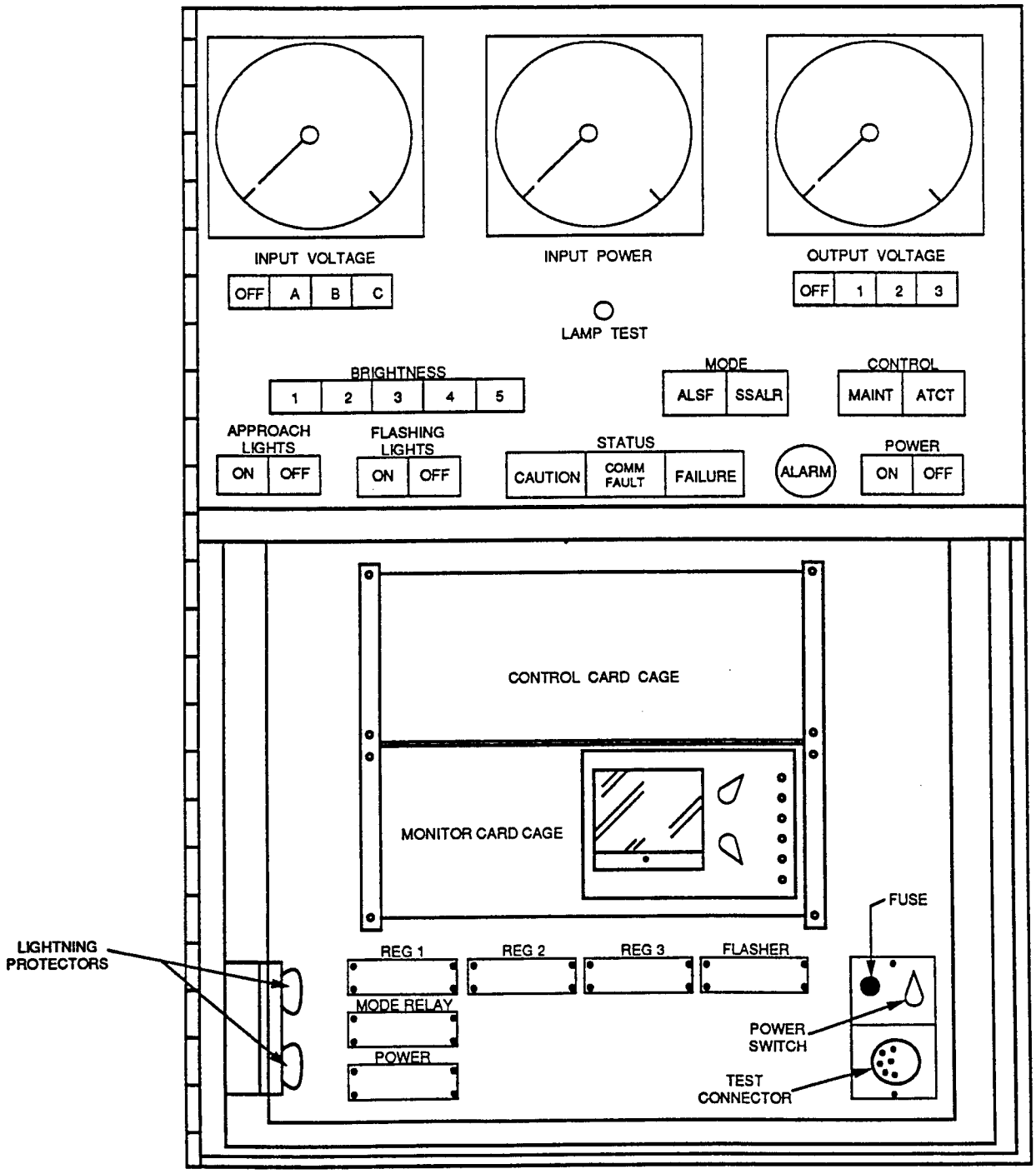

Figure 12. Typical Substation Control and Monitor Unit

3.3.9 Individual control cabinet.- The cabinet shall be a NEMA 4X enclosure made of stainless steel, fiberglass, or anodized aluminum. It shall be of sufficient size to accommodate all of the necessary components and wiring and allow for easy field installation and maintenance. Two 2-inch threaded fittings shall be provided on the bottom of the cabinet to allow for the mounting of the cabinet. Mounting lugs or bolts shall also be provided on the back of the cabinet to enhance the stability of the cabinet by using an additional mounting attachment when necessary. A third fitting on the bottom of the cabinet shall be provided to accommodate a 3/4-inch (1.9 cm) flexible conduit. The 3/4-inch fitting shall be provided with a 3/4-inch plug. Warning signs as specified in 3.4.12 shall be installed in the cabinet.

3.3.10 Junction boxes.- Junction boxes shall be in accordance with FAA Drawing D-5140-2. However, the terminal block indicated in the above drawing shall be of the type specified in 3.5.1.8, and the box shall be made of stainless steel or anodized aluminum. Also, the 1-inch (2.54 cm) conduit shall be replaced by two 2-inch (5.08 cm) conduit hubs at the bottom of the box. The centerlines of the hubs shall be 8 inches (20.32 cm) apart. Junction boxes will serve as convenient distribution points to interconnect cables from the flasher master controller to the individual control cabinets.

3.4 System requirements.- The system shall be designed using modular construction concepts for ease of maintenance, shall employ plug-in printed wiring boards where practical, have interchangeable parts between like systems, have readily accessible test points for all major signals, and have lightning and transient protection. All energized surfaces and points (except test points on printed circuit boards) shall be insulated or covered to prevent electrical shock.

3.4.1 Power quality requirements.- The interruption of primary power or voltage variations of up to 15% either at the substation or the ATCT, for short or long durations, shall not cause the system to restart in an undefined state upon restoration of the power. Power variations shall not cause any damage to the equipment. All commands shall be permanently stored and shall not require intervention or reactivation from the operator upon restoration of power. Solenoid held devices shall not be employed. When a system is software controlled using microprocessors or similar devices, a battery driven power source shall be provided to maintain memory/logic in the circuitry for a minimum of two minutes during a power loss or a transfer of power source.

3.4.2 Modular construction.- All electronic, electrical, and mechanical components shall be designed and constructed to minimize skill, experience, and time necessary to disassemble, assemble, and maintain them. All electronics shall be designed using plug-in printed wiring boards except where high voltage or high power devices are utilized. Similar functions shall be performed using identical modules wherever practical, and preference shall be given to designs which afford component replaceability.

3.4.2.1 Module.- A module is defined as being two or more basic parts that form a functional assembly that is a portion of a larger assembly or unit. The module is easily removed intact and replaced by plug-in, unsoldering, quick-disconnect, fastener, or equivalent means. It may or may not contain printed circuitry and it may contain active or passive devices.

3.4.3 Interchangeability.- All like components of each system shall be interchangeable between systems, and identical units within each system shall be interchangeable. Identical components shall be identified with identical part numbers and unlike parts shall not have the same part number. This requirement does not prevent the readjustment of calibration of exchanged modules nor does it prohibit exchange of control panels due to the runway identification number. Interchangeability shall be in accordance with MIL-STD-454, Requirement 7.

3.4.4 Test points and controls.- Test points shall be provided on all signals that are required to be monitored during checkout, alignment, calibration, or during preventive maintenance procedures. Test points shall not be located in compartments with voltage points of 500 volts or more, and all test points shall be located so as to preclude accidental shock to personnel engaged in normal operating or maintenance activities. The removal of components, modules, or circuit cards shall not be required to gain access to test points or adjustments. Test point controls and indicators mounted on printed wiring boards shall be accessible from the front of the circuit cage assembly without the use of extender boards.

3.4.4.1 Remote maintenance monitoring test points.- Test points and controls shall be terminated in a central location within the equipment cabinet. The termination shall be in a female connector to allow easy connection to an external remote maintenance monitoring system and to be used during preventive maintenance procedures.

3.4.4.1.1 Remote electronic chassis test connector.- The connector use in the remote electronic chassis for remote maintenance monitoring purposes shall be MIL-C-24308 with the pin

THIS PAGE INTENTIONALLY LEFT BLANK

assignments as shown in table XI. The test points listed in table XI are the minimum number of test points required for the remote electronics chassis.

3.4.4.1.2 Substation control and monitor test connector.- Test connector used in the substation control and monitor subsystem for remote maintenance monitoring shall be MIL-C-24308 with the pin assignments as shown in table XII.

3.4.4.1.3 Flasher master controller test connector.- The connector used in the flasher master controller for remote maintenance monitoring shall be MIL-C-24308 with the pin assignments as shown in table XIII. The trigger and flasher monitor signals shall be multiplexed into two lines and fed to terminals k and l, respectively.

3.4.4.1.4 Individual control cabinet test connector.- The connector used in the individual control cabinet for remote maintenance purposes shall be a type MS 3102, or equal, with 24 pins. The pins assignments shall be as shown in table XIV.

3.4.5 DC power supplies.- The dc power supplies shall be protected from overloads and short circuits, and shall provide the following regulated power.

(a) For control and monitor, and flasher master controller: 24 ± 4 V dc with an output current of 3.5 A dc minimum and having a ripple of 50 Mv rms maximum; +15.0 ± 0.5 V dc and -15 ± 0.5 V dc with output tracking of ± 1

Table XI. Remote Electronics Chassis Test Connector

Pin No.	Signal	Pin No.	Signal
A	Enable Indicator Brightness 1	Y	Brightness 3
B	Enable Indicator Brightness 2	Z	Brightness 4
C	Enable Indicator Brightness 3	a	Brightness 5
D	Enable Indicator Brightness 4	b	Generator Input
E	Enable Indicator Brightness 5	c	Generator Output
F	Enable Indicator ALSF	d	Lights On
H	Enable Indicator SSALR	e	120 V ac
J	Enable Indicator Lights Off	f	+5 V dc
K	Enable Indicator Lights On	h	+24 V dc
L	Enable Indicator Flasher On	j	+15 V dc
M	Enable Indicator Flasher Off	k	-15 V dc
N	Enable Indicator Local	l	Power Ground
P	Enable Indicator Caution	m	Receive Carrier
R	Enable Indicator Failure	n	Transmit Carrier
S	Enable Indicator Communication Fault	p	Transmit Synchronization
T	Enable Indicator Audio	r	Receive Sychronization
U	Flasher On	s	Low Tone Alarm
V	ALSF	t	Endec Clock
W	Brightness 1	u	Transmit Serial Data
X	Brightness 2	v	Communication Fault
AA	Local Brightness 5	w	Local Brightness 1
		x	Local Brightness 2
		y	Local Brightness 3
		z	Local Brightness 4

Space shall be provided in the cabinet for all external cable connections. Terminal blocks shall be located near the cable entrance to permit terminations of all external power and control wires feeding into the cabinet. Mounting lugs or bolts shall be provided on the back of the cabinets for mounting the cabinets vertically. Enclosures shall be stainless steel or aluminum sheet. Aluminum enclosures shall be anodized in accordance with MIL-A-8625.

3.4.8.1 Door gasket.- Indoor cabinets shall have either continuous molded gaskets or strip gaskets. Outdoor cabinets shall have continuous molded gaskets. If strip gaskets are used; (a) the total number of strips used shall not exceed four, (b) the vertical and horizontal runs shall be continuous except where the vertical strips meet the horizontal strips, and (c) the horizontal strips shall overlap the vertical strips. The gaskets shall be neoprene and shall be resistant to deterioration such as cracking, hardening, or softening under the environmental conditions the equipment will operate in.

3.4.8.2 Cabinet door.- All cabinet doors shall open from the right side of the cabinets. The door hinge may be internally or externally mounted and shall be corrosion resistant. A doorstop shall be provided for locking the door in a 120 degree open position.

3.4.8.3 Cabinet door handle.- The door handle lever shall have provision for padlocking it closed in the vertical position. The holes for the padlock shall be aligned such that a 3/8 inch (0.95 cm) diameter rod can be passed horizontally through the holes when the door handle is in a locked position. The handle shall activate a two-point shoot bolt to firmly secure the door in the closed position. The door handle shall be within 2 degrees of vertical when locked and shall keep the door completely closed regardless of what type or size of padlock is used.

3.4.8.4 Instruction book holder.- An instruction book holder shall be attached to the inside of cabinet doors larger than 2 square feet (0.37 square meter) (except for the individual control cabinet). The holder shall form a pocket for an 8-1/2-inch by 11-inch (216 by 279 mm) instruction book (3.7.2) and shall be made of the same material as the cabinet door.

3.4.8.5 Panel door cables.- Parts mounted on a hinged panel shall be wired to the other parts by means of a single cable, arranged to flex without being damaged when the panel is opened and closed.

3.4.9 Earth grounding.- The system covered by this specification shall meet all specification requirements when each unit of the complete system is connected to a good earth ground at the unit installation site. Equipment shall be provided with a grounding lug having a slotted, hexagonal, green-colored head suitable for a No. 6 bare copper ground wire.

3.4.10 Nameplates.- The ALS equipments shall have nameplates in

accordance with FAA-G-2100, paragraph 3.10. Nameplates shall be attached to the outside surface of the equipment using type 430 or 18-8 stainless steel rivets or drive screws.

3.4.11 Assembly and marking.- All components shall be properly assembled and marked. Each electrical/electronic component or part thereof shall be identified by a reference designation marked adjacent to the physical location of the part of the equipment and readily visible to maintenance personnel. Such identification shall be identical to reference designations used in instruction books for the equipment. Marking shall be in accordance with FAA-G-2100, paragraph 3.9.

3.4.12 Warning signs.- All contacts, terminals, and parts having voltages in excess of 500 V (rms) shall be clearly marked "DANGER HIGH VOLTAGE". Warning signs shall be placed as close as possible to the point of danger. Markings shall have red letters (a minimum of 1/2 inch (12.7 cm) high) on a white or clear background.

3.4.13 High voltage insulation.- Insulation and insulating materials used in the high voltage input and output cabinets, and in the constant current regulator, shall be rated for at least 5,000 V ac service. Insulation resistance shall be greater than 50 megohms, when measured using 15 Kv dc. Designs shall be consistent with the surge withstand capability (SWC) of ANSI C37.90.

3.4.14 Software/firmware requirements.- Newly developed ALSF-2/SSALR software shall be implemented using a high order programming language as approved by the Government. The software shall be designed, developed, documented, and tested according to software development requirements specified by FAA-STD-026 and all requirements of DOD-STD-2167A except the following paragraphs which have been deleted in their entirety: 4.1.5, 4.2.2, 4.3.2, 4.4.2, 4.6.3, 4.6.4.b, 4.6.4.c, and 5.5.4.a. References to the source code have been deleted from the following paragraph of DOD-STD-217A: 5.6.4.c, 5.7.4.b, and 5.8.4.

3.4.14.1 Operating system (OS) requirements.- If used, the operating system shall be a vendor supplied commercial-off-the-shelf software product.

3.4.14.2 Defensive coding.- The software shall be designed such that operator actions (i.e., inadvertently causing the system to halt, causing the system to stop performing the functions required by this specification, executing an incorrect command, executing out-of-limit parameters, and other operator-induced errors) shall not cause the incorrect operation of the system.

An incorrect input shall cause the system to respond with an error message and a prompt to aid the operator in providing a correct input. All such messages shall not require additional references or technical orders.

3.4.14.3 Operating parameters.- All operating parameter adaptations and limits, routing indicators and addresses, and priorities shall be changeable by the user/operator without a software change. Only minimal references will be required to make changes. Operators shall not be required to set up a database each time the system is initialized. All variables will have a default option that requires no operator intervention for selection.

3.4.14.3.1 Initialization/restart.- System initialization or restart shall be menu-driven with prompts.

3.4.14.3.2 Switch action.- Routine keyboard inputs shall only require a single key entry. Control key inputs shall be used only when necessary and for actions that could interrupt/halt the system or software. The desired method is a dual day entry with an operator prompt/response required.

3.4.14.4 Software utility services.- All processors that are software or firmware programmable shall be delivered with the necessary capability to develop and maintain the programmed logic. For firmware, this capability shall include a complete description of the logic and methodology and capability to modify the logic. All software and firmware provided shall be delivered with, and be reproducible from source materials. All delivered programs shall be capable of reconstruction on the delivered support configurations. This support software shall provide the following minimum capabilities:

(a) Compilation

(b) Assembly that produces relocatable object code

(c) Linking loader

(d) Generation, maintenance, and initialization of storage media for programs and data

(e) Diagnostics to support fault isolation

(f) Editing and debugging tools

(g) Test tools

3.4.14.5 System error messages.- System error messages concerning equipment, configuration, operator attention, and abnormal execution alarms shall be standardized. The generation of error/diagnostic messages shall make a distinction between the requirements for on-line messages (to facilitate real-time fault isolation required to maintain the system in operational status) and the logging of fault messages onto system files for the category of faults that require isolation and correction, but can be addressed off-line and do not degrade the system performance. The required processing time to identify and generate error/ diagnostic messages, either for immediate or off-line isolation and correction, shall not degrade the operational requirements of the system.

(a) Processor messages and advisory formats shall not require additional interpretation by the operator, such as table look-ups and references to documentation, with the exception of lengthy diagnostic procedures to be followed by the operator after an abnormal condition.

(b) No computer program shall generate a message or advisory identical to one generated by the OS or by another program operating in the ALSF-2/SSALR system.

(c) Off line error messages shall contain, as a minimum, the following information:

1 Time error was detected

2 The memory location from which the error routine was entered

3 Textual description of condition

4 Program identification

5 Required operator action, where applicable

6 Contents of instruction register and program counter at time of error

7 Identification of triggering module

8 Computer program or system execution status following the error

On-line error messages shall contain, as a minimum, the information in items 1, 3, and 5 above.

3.4.14.6 System growth capabilities.- The processing configuration (including microprocessors and microcomputers) shall provide the following capabilities for growth:

(a) Memory: The computer configuration shall include sufficient capacity to accommodate an increase of on-half in all computer program modules and data structures with no modifications in equipment, no restructuring of modules or data structures, and no resequencing of input/output operations.

(b) Central processing unit (CPU): Under worst-case CPU loading, the delivered CPU usage shall not be greater than 75 percent of capacity.

(c) Upward expandability: The delivered configuration shall either include, or permit by addition of units without induced change, modification, or redesign to the software/hardware components comprising the basic configuration a further 100 percent increase in the capacity of primary memory.

All of these margins for growth shall exist at the time of delivery. Analysis, proving that the requirements are met, shall be presented at PDR and CDR for Government approval.

3.4.15 RMS functional requirements.- The ALSF-2/SSALR RMS shall meet the functional requirements of NAS-MD-793 as augmented below and the requirements of NAS-MD-790A. All data provided to the RMS interfaces (parameter values, measurements, standards, tolerances, and diagnostic test results) shall be conditioned and reported in the correct engineering units. The RMS data transmitted over the data link between the ATCT and the ALSF-2 substation shall utilize, as a maximum, one unshielded, twisted pair of 19 gauge wire.

3.4.15.1 Monitoring requirements.- All monitored data and reports shall be time stamped at the RMS. In addition, the RMS shall monitor environmental parameters to provide data on the ambient environmental and physical security conditions at the ALSF-2/SSALR equipment and engine generator shelters. Table XIVa lists the controlled functions of the monitoring system.

3.4.15.2 Alarm limits.- ALSF-2/SSALR and environmental equipment parameter values shall be collected on a regular and frequent basis (see 3.4.15.7.3). The RMS shall process the outputs of the sensors to determine hard and soft alarm status by comparing the monitored outputs with predetermined values. All hard and soft alarm thresholds shall be site adaptable. Thresholds for currents and voltages shall be adaptable to ± 40 percent of their specified values.

TABLE XIVa. ALSF-2/SSALR CONTROLLED FUNCTIONS

Controlled Function	Possible Status
ALSF-2/SSALR (available to both the local maintenance data terminal and the maintenance processor sub-system)	
RMS Diagnostics	(PASSED/FUNCTION "X" FAILED)
ALSF-2/SSALR Diagnostics	(PASSED/LRU, LIGHT BAR, and/or LAMP "X" FAILED)
Establish System Parameters	PARAMETERS TEMPORARILY/ PERMANENTLY) INSTALLED
Alarm, Alert Enable/Disable	(ENABLE/DISABLE)
Reset ALSF-2 RMS (SUCCESSFUL/UNSUCCESSFUL)	RESET
Reset ALSF-2 Microprocessors (SUCCESSFUL/UNSUCCESSFUL) (when used)[1]	RESET
ALSF-2/SSALR (available from local maintenance data terminal)	
a. Display Menu	-
b. Display System Status	-
c. Display Certification Parameters	-
d. Display Performance Checks	-
e. Display Key Equipment Performance Parameters	-
f. Display Status of a Parameter	-
g. Abort Command in Progress[2]	-
h. Time synchronization	-
i. ALS	(ON/OFF)

TABLE XIVa. ALSF-2/SSALR CONTROLLED FUNCTIONS (cont.)

Controlled Function	Possible Status
j. ALS Brightness	(1/2/3/4/5)
k. Flasher lights	(ON/OFF)
l. Mode	(ALSF-2/SSALR)
m. RMS Control Mode	MDT/MPS
n. Send Terminal Message	-
ALSF-2/SSALR (available from maintenance processor subsystem)	
a. ALS	(ON)
b. ALS Brightness	(1/2/3/4/5) MPS May Increase Intensity Only
c. Flasher lights	(ON)
d. Mode	(ALSF-2)

[1] Available to the MDT at anytime; available to the MPS only when the remote control panel is in ALARM.
[2] Available only for commands that take longer than 20 seconds to implement.

3.4.15.3 Control command requirements.- The RMS shall provide for the capability to assess performance parameters, diagnose, and change ALSF-2/SSALR equipment status from the MPS or MDT interfaces. Control commands shall be exercised within the following constraints:

a. The MPS shall not be capable of controlling ALSF-2 operational functions when the ALSF-2 has been turned on at the ATCT.

b. The MPS shall be capable of exercising any maintenance function that does not affect operational functions when the ALSF-2 has been turned on at the ATCT.

c. The MPS shall have full control of all ALSF-2 operational and maintenance functions when the ALSF-2 has been turned off at the ATCT and the substation

control panel control switch is in the ATCT position. Control of ALSF-2 operational functions under this scenario shall be limited to a period of not greater than one to twenty minutes. This one to twenty minute period of MPS operational control shall be site adaptable in increments of one minute.

d. The RMS shall be capable of immediately returning operational control of the ALSF-2 system to the ATCT from the MPS when a function change is selected at the remote control panel.

e. An audible and visible alarm shall be generated at the remote control panel and at the substation control panel whenever the MPS or the MDT take operational control of the ALSF-2.

f. The MPS shall have no control when the control MAINT button has been selected on the substation control panel.

g. The MDT shall have control of all ALSF-2 functions when the maintenance control button has been selected (see table V). The MDT shall have control of maintenance functions only when the maintenance control button has not been selected.

h. The ALSF-2 RMS shall have two modes of operation: 1) a remote mode, and 2) a local mode. The capabilities and limitations of the MPS and the MDT in each mode (local and remote) and for each configuration (MDT logged in and MDT not logged in) shall be as described in table XIVb.

Table XIVb. RMS Operating Modes and Configurations

Modes and Configurations	Available Functions				
	RMS Status		RMS Control		Other
	MPS	MDT	MPS	MDT	
Remote Mode					
MDT not logged in	Yes	No	Yes	No	RMS provides Login Prompt to the Local Terminal Interface
MDT logged in	Yes	Yes	Yes	No	
Local Mode (MDT logged in)	Yes	Yes	No	Yes	

3.4.15.3.1 MPS interface commands.- In addition to the capability to respond to the polling requirements of NAS-MD-790A, the following commands shall be incorporated into the RMS and shall be executed upon receipt of commands from the MPS interface.

(a) Diagnostic routine check (3.4.15.3.2.8)

(b) Turn approach lights on (3.4.15.3.2.10)

(c) Brightness step (1-5) (3.4.15.3.2.11)

(d) Flasher lights on (3.4.15.3.2.12)

(e) Reset (3.4.15.3.2.13)

(f) Time synchronization with MPS (3.4.15.3.2.14)

3.4.15.3.2 MDT interface commands.- The following command shall be incorporated into the RMS and shall be executed upon receipt of commands from the MDT interface.

(a) Display menu (3.4.15.3.2.1)

(b) Display system status (3.4.15.3.2.2)

(c) Display certification parameters (3.4.15.3.2.3)

(d) Display performance checks (3.4.15.3.2.4)

(e) Display key equipment performance parameters (3.4.15.3.2.5)

(f) Display status of a parameter (3.4.15.3.2.6)

(g) Abort command in progress (3.4.15.3.2.7)

(h) Diagnostic routine check (3.4.15.3.2.8)

(i) ALSF-2/SSALR mode (3.4.15.3.2.9)

(j) Turn approach lights on/off (3.4.15.3.2.10)

(k) Brightness step (1-5) (3.4.15.3.2.11)

(l) Flasher lights on/off (3.4.15.3.2.12)

(m) Reset (3.4.15.3.2.13)

3.4.15.3.2.1 Display menu command.- The ALSF-2/SSALR RMS shall include a display menu command. Execution of the display menu command shall provide a listing of all menu items including the commands in 3.4.15.3.2 above.

3.4.15.3.2.2 Display system status.- The ALSF-2/SSALR RMS shall implement a display system status command. The display system status command shall be executed upon receipt of a unique command. Execution of the display system status command shall provide a report of the status of the ALSF-2/SSALR and environmental equipment including as a minimum the ALSF-2/SSALR monitored parameters of table Xa. The report shall also contain, all system input voltages and currents, all cabinet, regulator, subsystem input and output voltages and currents, and all power supply input and output voltages and currents. See paragraph 3.2.10.1.

3.4.15.3.2.3 Display certification parameters.- The AlSF-2/SSALR RMS shall implement a display certification parameters command. This command shall be executed upon receipt of a unique command and provide a report containing the date and time, the services provided, the certification parameters, standards and tolerances, and measured values as identified in paragraph 3.2.10.3.

3.4.4.15.3.2.4 Display performance checks.- The ALSF-2/SSALR RMS shall implement a display performance checks command. This command shall be executed upon receipt of a unique command and provide a report containing the date and time, periodicities of performance checks, performance checks, standards and tolerances, and measured values as identified in the instruction book (see paragraph 3.2.10.4).

3.4.15.3.2.5 Display key equipment performance parameters.- The ALSF-2/SSALR RMS shall implement a display key equipment performance parameter command. This command shall be executed upon receipt of a unique command and provide a report containing the date and time, inside temperature, outside temperature, parameters, standards and tolerances, alarm status, and measured value as identified in the instruction book (see paragraph 3.2.10.2).

3.4.15.3.2.6 Display status of a parameter command.- The ALSF-2/SSALR RMS shall implement a display status of a parameter command. The display status of a parameter command shall be executed upon receipt of a unique command. It shall be possible to separately specify each of the parameters of 3.4.15.3.2.2, 3.4.15.3.2.3, 3.4.15.3.24., and 3.4.15.3.2.5. The single line shall contain the parameter name, standard, the alarm status, and monitored value (as applicable) for that parameter exactly as the line for that parameter would be displayed in the reports specified.

3.4.15.3.2.7 Abort command in progress.- The ALSF-2/SSALR RMS shall implement an abort command in progress command. This command shall be available only for commands that take more than 20 seconds to implement. Execution of the abort command in progress command shall cause the RMS to cease execution of any interface command currently being executed.

3.4.15.3.2.8 Diagnostic routine check.- The ALSF-2/SSALR RMS shall implement the diagnostic routine check command. The command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the diagnostic routine check shall cause the RMS to execute the diagnostic routine of 3.4.15.4. The results of the diagnostic shall be sent by the RMS to the requesting interface.

3.4.15.3.2.9 ALSF-2/SSALR mode.- The ALSF/SSALR RMS shall implement the ALSF-2/SSALR mode command. The command shall be executed upon receipt of a unique command from the MDT interface. Execution of the command from the MDT or the MPS shall cause the RMS to change from ALSF-2 mode of operation to SSALR mode or vice versa.

3.4.15.3.2.10 Turn approach lights on/off.- The ALSF/SSALR RMS shall implement the turn approach lights on/off command. The on/off command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the on/off command shall cause the approach lights to be activated or deactivated.

3.4.15.3.2.11 Brightness step (1-5).- The ALSF/SSALR RMS shall implement the brightness step commands. The command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the command shall cause the approach lights to be stepped from brightness steps one to two, two to three, three to four, and four to five as well as the reverse order. Execution of the reverse order of brightness steps from the MPS interface shall not be allowed.

3.4.15.3.2.12 Flashing lights on/off.- The ALSF/SSALR RMS shall implement the flashing lights on/off command. The on/off command shall be executed upon receipt of a unique command from either the MDT or MPS interface. Execution of the on/off command shall cause the flashing lights to be activated or deactivated.

3.4.15.3.2.13 Reset.- The ALSF-2/SSALR RMS shall implement a reset command. Execution of the reset command shall cause the RMS to reset the RMS and initiate the time synchronization sequence of paragraph 3.4.15.3.2.14 below.

3.4.15.3.2.14 Clock sync request message.- The RMS shall provide a clock sync request message in accordance with NAS-MD-790A, paragraph 3.5.4. The clock sync request message shall be automatically generated for transmission to the MPS whenever the RMS recovers from a power fault and whenever the RMS is reset. In addition, the RMS shall also generate clock sync request messages to the MPS at intervals frequent enough to maintain the RMS time to within six seconds of MPS time but not more frequently than once every twelve hours and not less than once every twenty-four hours. Execution of this command shall cause a software routine to synchronize the RMS clock to within two (2) seconds of the MPS clock.

3.4.15.3.2.14.1 Clock sync message.- The RMS shall accept and execute a clock sync message from the MPS in accordance with NAS-MD-790A, paragraph 3.5.5.

3.4.15.3.2.14.2 Clock delay adjustment.- The RMS shall be capable of incorporating a site adaptable, fixed time delta to account for transmission delays in the clock update routine.

3.4.15.4 Diagnostics requirements.- The RMS shall provide the capability for diagnosing ALSF-2/SSALR equipment faults to the LRU level. Diagnostics shall provide the identity of the failed LRU, light bar or lamp, and parameter values, and provide data reports when requested from the MPS and MDT interfaces. When an MDT is connected to the RMS, the diagnostics shall be automatically initiated by the RMS and transmitted to the MDT under the following conditions:

(a) Power is applied to the RMS

(b) A hard or soft alarm occurs except when the condition is the result of an environmental sensor parameter

(c) RMS reset is activated

3.4.15.4.1 Fault isolation.- The diagnostics shall isolate faults to a single LRU in 95% of diagnostic attempts. In the 5% of attempts remaining, the faults shall be isolated to no more than two LRUs.

3.4.15.5 Physical security requirements.- The physical security function shall provide for the intrusion and smoke detection monitoring and reporting for the ALSF-2/SSALR and engine generator shelters (shelters are not a part of this specification).

3.4.15.6 MDT process security requirements.- The process security function shall control access to and use of the RMS display and control functions. The RMS shall sense for the connection of a MDT to its serial port, and offer a prompt for entry sign-on. A two-step sign-on command, when correctly entered, shall cause the RMS to respond to subsequent commands. Since the user password identifiers equate to various levels of security, each command entry shall be validated against the applicable security level list before execution. Each sign-on command entry shall be reported to the MPS. At least 24 unique six-character user password identifiers shall be provided.

3.4.15.6.1 Authority.- The first level password (highest) shall give access to all possible software adaptations, data displays (including certification data), commands, and diagnostics. The second level shall be restricted to data displays, and diagnostics. The third level shall provide access to the ALSF-2/SSALR system status and key equipment performance parameter displays only.

3.4.15.7 RMS performance requirements.- The RMS performance function shall control the monitoring and recording of performance data on the hardware/software/firmware components of the RMS; and provide the means for detecting failures and unacceptable performance of the RMS.

3.4.15.7.1 Monitoring requirements.- In addition to the requirements of 3.2.10, the design of the ALSF-2/SSALR RMS shall include sensors and processes to monitor the performance of the RMS hardware, software, and firmware. The actual determination of a failure or impending failure of the RMS shall be accomplished as part of the alarm recognition processing described for the Alarm Function.

3.4.15.7.2 System integrity.- Failures of or in the RMS or associated telecommunications equipment shall not cause failures in, or in any way degrade the Air Traffic operational or Air Traffic Control Tower status and control capabilities of the ALSF-2/SSALR. The RMS shall be completely independent of the ALSF-2/SSALR operating system and the status and control functions of the Air Traffic Control Tower. Certain control functions (listed in paragraph 3.4.15.3.1) initiated from the MPS interface shall be limited to prevent accidental changes in operational status.

3.4.15.7.3 RMS sampling frequency.- The ALSF-2/SSALR RMS shall sense each key equipment performance (3.2.10.2) and certification parameter (3.2.10.3) no less than once every two (2) seconds.

3.4.15.7.4 Alert and alarm determination.- The RMS shall determine an alarm or alert condition and provide an indication of the condition to the local status file within an average time of two (2) seconds and a maximum time of ten (10) seconds.

3.4.15.7.5 Change of state determination.- The RMS shall determine a change of state and provide an indication of the state to the local status file within an average time of two (2) seconds and a maximum time of ten (10) seconds.

3.4.15.7.6 Performance parameter request.- The RMS shall gather performance parameter or diagnostics data for a single report and queue the data in the output buffer within an average time of fifty (50) seconds and a maximum time of four (4) minutes.

3.4.15.7.7 Command execution.- The RMS shall execute control commands (that cause a state change) or test commands within an average time of two (2) seconds and a maximum time of five (5) seconds where this time is measured from receipt of the last byte of the command in the input buffer of the RMS to the time the command is completely executed.

3.4.15.7.8 Communications requirements.- The RMS shall be capable of supporting the transfer of messages of up to 512 characters to the MPS within an average time of five (5) seconds and a maximum time of ten (10) seconds at a rate between 2400 and 9600 bits per second (bps). This time is measured from the acceptance of the first byte of the message by the communication subelement to receipt of the last byte of the message in the input buffer of the MPS.

3.4.15.8 System initialization requirements.- The system initialization function shall verify that the RMS is fully operational, and will load initial parameters from nonvolatile memory. The function shall then permit authorized system users to clear or set counters and registers to their starting values, and to load any necessary variable or constant values which have to be reloaded before an RMS can be started after an equipment or power failure, and to restart the RMS.

3.4.15.8.1 Startup.- Startup of the RMS shall be initiated from the MPS or MDT or automatically upon application of AC power. Upon receipt of the startup command, the RMS shall execute required actions to restart the RMS, perform self-tests, clear registers, reset counters, etc.

3.4.15.9 MDT communications.- MDT communications support shall be in accordance with NAS-MD-793, paragraph 3.3.5.

3.5 Parts, materials, and processes.- Parts, materials, and processes selected for use in this equipment shall be in conformity with specific requirements herein.

3.5.1 Parts.- Parts shall be as specified herein.

3.5.1.1 AC power connections.- AC line control circuits, parts, and protective devices shall meet the requirements of FAA-G-2100, paragraph 3.3.2.1.1 through 3.3.2.2.

3.5.1.2 Discrete components.- Discrete components shall be in accordance with the following requirements of MIL-STD-454.

(a)	Capacitors	Requirement 2
(b)	Connectors	Requirement 10
(c)	Controls	Requirement 28
(d)	Indicator lights	Requirement 50
(e)	Relays	Requirement 57

(f) Resistors Requirement 33

(g) Switches Requirement 58

(h) Transformers, inductors Requirement 14

(i) Contractors shall be in accordance with MIL-C-22896

3.5.1.2.1 Flasher assembly capacitors.- All flash capacitors shall be rated 25 percent above operating voltage and shall be designed for the intended application. They shall have a life expectancy of at least 1 year of continuous duty at a normal working voltage.

However, if their use cannot be avoided, they shall be in accordance with MIL-STD-454, requirement 16. All sharp edges on all metal parts shall be filed. Where applicable, all exposed edges and corners shall be rounded to a minimum of .75 mm (.03 in) radius. Sharp edges and corners that present a personal safety hazard or potential damage to equipment during usage shall be protected or rounded to a minimum radius of 13 mm (1/2 in).

3.5.2.2.1 Ductile iron.- Heat-treated ductile iron, if used, shall have the proper tensile and yield strength to meet the requirements set forth herein. Particular attention shall be paid to the proper Brinell hardness and elongation of the material. Protection plating as specified in 3.5.3.2 shall be used on all cast and machined ductile iron surfaces.

3.5.2.2.2 Stainless steel.- type 18-8 stainless steel shall be used for all bolts, nuts, and washers not subject to high stress requirements. Bolts subject to direct stresses resulting from forces applied to the top surface of the Type II flasher light unit shall be high strength Type 410 stainless steel, heat-treated to Rockwell C-21 to C-23 (110,000 psi tensile strength), and given a black oxide coating per MIL-C-13924, Class 3, after heat treatment. At the Option of the contractor, stainless steel may be used for any purpose for which another material is not definitely specified elsewhere herein or elsewhere in the contract specifications, provided that all stainless steels are of the following types:

American Iron and Steel Institute (AISI) Type Numbers

301	305	316L
302	308	317
302B	309	321
303	310	322
304	314	322
304L	316	347

3.5.2.2.3 Aluminum.- Aluminum shall be in accordance with Federal Specifications QQ-A-200/9 and QQ-A-225. Aluminum alloy plate and sheet, aluminum alloy die castings, and aluminum alloy sand castings shall be in accordance with Federal Specifications QQ-A-250, QQ-A-591 and QQ-A-601, respectively. Aluminum alloy castings, if used, shall be impregnated in accordance with MIL-STD-276. All aluminum parts shall be anodized in accordance with MIL-A-8625.

3.5.3 Protective coatings.- Protective coatings used for prevention of corrosion shall be as specified herein.

THIS PAGE INTENTIONALLY LEFT BLANK

3.5.3.1 Anodizing.- Aluminum parts on the exterior of the Type II flasher light unit which would be exposed to continuous moisture, salt-laden atmosphere, or mechanical damage, shall be teflon penetrated, hardcoat anodized, and meet the requirements of MIL-A-8625, Type I or Type II, Class 1 or Class 2, as applicable.

3.5.3.2 Plating.- All iron and steel parts used outdoors shall be zinc or cadmium-plated in accordance with QQ-Z-325 or QQ-P-416.

3.5.4 Glass.- Glass used as an optical or structural part shall meet all requirements of this specification, which includes the requirements of MIL-C-7989 for Class B glass. Class C glass may be used if required for impact strength. The glass used shall be made of borosilicate glass having an average Young's Modules of 9.1 by 10 to the sixth power and a Poisson's ratio of 0.2, or equivalent. The glass shall be tempered to withstand thermal shock (3.6.2.8). Glass parts shall be supported in such a way that they will not be damaged by vibrations, shocks, or defection of any component part.

3.5.5 Gaskets.- Gaskets used in separable joints for cushioning and sealing purposes shall be capable of sustained operation at ambient temperatures of -55 C (-67 degrees F) to +70 degrees C (+158 degrees F). The gaskets shall be made of neoprene.

3.5.6 Adhesives.- Adhesives, if used, shall be in accordance with MIL-STD-454, requirement 23.

3.5.7 Processes.- All processes used in the assembly or manufacture of equipments used in this system shall be suitable

for the intended purpose.

3.5.7.1 Brazing.- Brazing shall be in accordance with MIL-STD-454, requirement 59, except that electrical connections shall not be brazed.

3.5.7.2 Cabling.- Internal wiring practices shall be in accordance with MIL-STD-454, Requirement 69. Selection and application of cable and wire for interconnection between units shall be in accordance with MIL-STD-454, Requirement 71. All wire used in making circuit connections (other than RF) shall have a cross-section area to current ratio of not less than 500 circular mils per ampere.

(a) Electrical wire shall be in accordance with MIL-STD-454, Requirement 20.

(b) Coaxial radio frequency (RF) transmission cable shall be in accordance with MIL-STD-454, Requirement 65.

(c) Multiconductor cable shall be in accordance with MIL-STD-454, Requirement 66.

3.5.7.3 Cable breakout wires.- Each individual breakout wire lead which emerges from a cable shall be longer than necessary for its termination with approximately 1 inch (25 mm) of slack wire neatly formed adjacent to its termination.

3.5.7.4 Soldering.- Soldering shall be accordance with MIL-STD-454, requirement 5.

3.5.7.5 Lugs connected to screw terminals.- Where wires are connected to solderless or solder lugs which are clamped under screw terminals so as to be removable by loosening or removing the screws, not more than one wire shall be attached to each lug, so that each wire can be removed individually from the screw terminals. Not more than three lugs shall be attached to each screw terminal.

3.5.7.6 Cable connector wiring.- Not more than one wire shall be attached to each contact to each connector, except that two wires may be attached to a crimp-type contact. The two wires connected together shall not exceed the size of the connector pin.

3.5.7.7 Splices.- Wires and cables shall not be spliced.

3.5.7.8 Finishes.- Finishes for indoor enclosures shall be in accordance with FAA-G-2100 paragraph 3.7.6.

3.5.7.9 Workmanship.- Workmanship shall be in accordance with MIL-STD-454, requirement 9.

3.6 Environmental requirements.- The equipment shall be designed for continuous operation under the environmental conditions specified in the following paragraphs.

3.6.2.5 Salt fog.- Exposure to salt-laden atmosphere.

3.6.2.6 Rain.- Exposure to wind-blown rain.

3.6.2.7 Solar radiation (sunshine).- Exposure to sunshine with ambient temperature as stated in 3.6.2.2.

3.6.2.8 Temperature shock.- Exposure of exposed surfaces (including light windows) to sudden application of cold water when the lights reach stable temperatures. (See 4.4.3.1 and 4.4.9.5).

3.6.2.9 Vibration.- The flasher light units types I and II shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 hertz in accordance with NEMA Standard FA1-3.01.

3.6.3 Impact.- Semiflush flasher light units shall be capable of sustaining impact loads (see 4.4.9.3).

3.6.4 Hydraulic impact.- The inpavement flasher light units shall be designed to withstand, without damage, hydraulic pressures which may be formed by aircraft tires moving at high speeds on the fixture during operations in wet weather.

3.6.5 Snowplow impact.- The semiflush flasher light units shall be designed to withstand, without functional damage, impact by steel blade of snowplows at speeds up to 30 miles per hour (mph) (48.2 kilometer per hour (kmph) (see 4.4.9.7).

3.6.6 Transient suppression.- The equipment shall be designed to withstand transient increases superimposed on the 120/240 V ac (rms) power line input that reach a peak value of 500 V for as long as 50 milliseconds. The indoor equipment shall be designed to withstand lightning transients, applied at the equipment input and output terminals. These lightning transients shall be characterized as 8 by 20 microseconds current surges of 3,000 amperes with the subsequent power-follow current, and 1.2 by 50 microseconds voltage surges of 6 Kv. The current and voltage waveforms are defined in ANSI standard C37.90. In addition, the outdoor equipment shall be designed to withstand lightning transients superimposed on the ac input and output power lines (excluding remote maintenance monitoring) characterized as 8 by 20 microseconds current surge of 5,000 amperes with the subsequent power-follow current and voltage surge of 10 Kv/microsecond minimum. The equipment shall resume normal operation automatically when an interruption or a shutdown is experienced due to a transient. Equipment performance and operational functions shall be unimpaired by the above transients

after each type of transient is imposed a minimum of 5 times to each ac input and output terminal while the equipment is energized. Lightning protectors shall be provided in accordance with FAA-STD-019 and FAA-STD-020 and the NFPA #78, Lightning Protection Code for all power lines at their first point of entry into the equipment, and at their exit from the equipment. The return terminal of the lightning protector shall be connected to earth ground via a separate dedicated conductor no less than a No. 6 American Wire Gage (AWG).

3.6.7 Interference requirements.- Conducted interference levels on the power leads, control leads, signal leads, and interconnecting cables between parts, shall not exceed the limits for CE03, as defined in MIL-STD-461 (equipment class A3). Similarly, radiated narrowband and broadband interference levels shall not exceed the limits for RE02 of MIL-STD-461 over the frequency range from 14 kilohertz (Khz) to 10 gigahertz (Ghz) at a distance of 20 feet (6.1 meters).

3.7 Instruction books.- Draft manuscript and camera ready reproducible copies of the instruction books in accordance with the requirements of specification FAA-D-2494 shall be furnished. The Government will reproduce instruction books and furnish copies to the contractor for shipment with the equipment. Two instruction books shall be included with each set of equipment comprising a system.

3.8 Reliability

3.8.1 Reliability design criteria.- The following equipment shall meet the listed reliability requirements:

Equipment (Test)	High Voltage Input & Output Cabinets	Regulator	Monitor and Control	Master Flasher Controller	Remote Monitoring Subsystem	Flasher Assemblies Type I/II	Aiming Device/ Flasher Tester
Power factor (4.4.6.4)		X					
Open circuit, over current, and surge protection (4.4.6.5)		X*					
Control functions (4.4.7.1)			X*				
Data transmissions (4.4.7.2)			X*				
Monitor operation (4.4.8.1)			X*				
Monitor calibration (4.4.8.2)			X*				
Photometric (4.4.9.1)						X*	
Static load (4.4.9.2)						X (Type II)	
Impact (4.4.9.3)						X (Type II)	

* See notes at end of table

Table XVI. Qualification and Production Tests

Equipment (Test)	High Voltage Input & Output Cabinets	Regulator	Monitor and Control	Master Flasher Controller	Remote Monitoring Subsystem	Flasher Assemblies Type I/II	Aiming Device/ Flasher Tester
Interference (4.4.3.7)		X	X	X	X	X	X
Sand and dust (4.4.3.8)						X	X
Solar radiation (4.4.3.9)						X	X
Insulation resistance (4.4.4)	X*	X*					
150-hour (4.4.5)	X	X	X	X	X	X	
Regulation (4.4.2.1)		X*					
Temperature (4.4.6.2)		X					
Efficiency (4.4.6.3)		X					

* See notes at end of table

4.4.5 150-hour test.- The system shall be connected together in accordance with 4.3.3 and tested as a system for a minimum of 150 hours at an ambient temperature of 30 degrees ± 10 degrees C (86 degrees ± 18 degrees F). Each functional control, brightness selector, mode control, status indicator, alarm circuit, and monitor channel shall be exercised to demonstrate full compliance with the specification. Any erratic switching, loss of control, or operation outside of the prescribed limits shall be cause for rejection. Operation of the monitor subsystem for loop 1, 2, and 3 shall be tested with the shorting devices installed in the PAR-56 lampholders. The following steps shall be performed during the test period:

(a) Each function (brightness and mode changes) shall be exercised at least once each hour during the test period.

(b) Each brightness level settings (B1 through B5) shall be activated for 3.5 minutes in each mode (ALSF/SSALR) every 10 hours.

(c) The system shall operate on each brightness level setting (B1 through B5) and each mode (ALSF/SSALR) for 10 hours, except for the hourly interruption mentioned in step (a).

(d) The proper operation of the alarm circuit shall be demonstrated by removing 10 lamps in each loop of the ALSF and SSALR circuits, and 3 lamps int he flashing light circuit. The test shall be done at the end of the 10 hour test (step (c)), and at the conclusion of the 150 hour test.

4.4.5.1 RMS operational test.- The ALSF-2/SSALR RMS functional requirements shall be tested using an MPS simulator. The synchronous MPS communications simulator, hereinafter referred to as the simulator, provides a means of simulating the communication functions, as defined below, of a single channel of an MPS. The data communications protocol between the simulator and RMS is as defined by the Remote Maintenance Monitoring Subsystem (RMMS) Interface Control Document, NAS-MD-790A. The simulator is designed to run on an IBM or an IBM-compatible personal computer (PC) with MS-DOS release 2.0 or higher and a minimum of 320K bytes of random access memory (RAM) with government furnished software that simulates an MPS interface to the RMS. The simulator hardware shall be provided by the contractor. The PC must also have an IBM synchronous data link control (SDLC) communications adapter card, an external clock with a baud rate of 2400 at RS-232 level, and a parallel printer port.

4.4.6 Regulator tests.- The tests as specified herein shall be performed on the regulators.

4.4.6.1 Regulation.- The regulators shall be tested to demonstrate full compliance with the requirements of 3.2.3.2. For production units, regulation need only be tested at nominal input voltage. Regulation testing shall also demonstrate compliance with the local and remote control and monitor requirements of 3.2.3.12 and 3.2.3.13.

4.4.6.2 Temperature rise.- Temperature rise testing as required by 3.2.3.5 shall be performed using the resistance method.

4.4.6.3 Efficiency.- The regulator shall be tested to demonstrate the efficiency requirement of paragraph 3.2.3.3.

4.4.6.4 Power factor.- The regulator shall be tested to demonstrate the power factor requirements of paragraph 3.2.3.4.

4.4.6.5 Open circuit, over current, and surge protection.- Testing shall be provided to demonstrate compliance with the requirements of 3.2.3.7, 3.2.3.8, 3.2.3.9, and 3.2.3.14.

4.4.7 Control functions tests.- Testing shall be provide for the control subsystem as required herein.

4.4.7.1 Control testing.- A test shall be provided which exercises each control on both substation control panel and the remote control panel, reads the status of each indicator, verifies proper timing relation, and demonstrates compliance with the functional requirements of 3.2.4.4.

4.4.7.2 Data transmission.- The output level and carrier detect specifications of the data transmission link shall be verified by testing. The transmission line loss may be simulated by an attenuator pad in lieu of having an actual 10 mile (16.1 km) transmission line. The mark and space transmitting frequencies shall be verified.

4.4.8 Operational monitor tests.- Tests shall be performed on the operational monitor subsystem as specified herein.

4.4.8.1 Operational monitor operation.- The ability of the operational monitor to detect the number of failed lamps (either open or shorted) in each loop within one lamp shall be verified by tests. The ability shall be tested in all brightness levels and in both modes (ALSF-2/SSALR). The system shall be able to detect from 1 to 10 failed lamps in ALSF-2 and from 1 to 5 in SSALR.

4.4.8.2 Operational monitor calibration.- Procedures shall be provided and demonstrated to verify that calibration of the operational monitor subsystem can be accomplished by one person within 30 minutes.

4.4.9 Flasher assembly tests.- The tests as specified herein shall be performed on the flasher assembly.

4.4.9.1 Photometric tests.- Photometric and like tests shall be conducted on the production model to determine compliance with the requirements as specified. Photometric tests shall be conducted in accordance with FAA-E-1100, Photometric Test Procedures for Condenser Discharge Lamps. A flash lamp of the type used in this system shall be calibrated by the National Bureau of Standards and used as a calibration standard for the tests. The photometric tests may be conducted with a Module 580-20 Radiometer System as manufactured by EG&G. Test results shall include a graph showing the effective isocandela curve for each intensity setting and oscilloscope photographs of the pulse shape and deviation. Production units shall be checked at the beam center, +15 degrees horizontally from the beam axis and $\pm$5 degrees vertically from the beam axis. Photometric tests shall be conducted on the semiflush production model before and after the static load, impact, vibration, and snowplow tests to determine the capability of the semiflush approach light assembly to comply with the requirements as specified when submitted to the tests.

4.4.9.2 Static load tests.- The semiflush production model shall be subjected to the load tests of 4.4.9.2.1 and 4.4.9.2.2 and show no evidence of cracking or breaking of the top assembly or of any other component which would cause leaks. There shall be no permanent distortion to cause shifting of the light output.

4.4.9.2.1 Distributed load test.- The semiflush production model shall be mounted in a test machine on a supporting ring equivalent to the LB-4 light assembly through a rubber pad having a Shore A hardness of 55 to 65. The rubber pad shall have a diameter equal to the diameter of the top assembly and thickness of 1-1/2 inches (38.1 mm). No filling material or support shall be used in the light output window cavity. A load of 160,000 pounds (72,574.7 kilograms (kg)) shall be applied to the rubber pad through a flat steel plate.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
No number	Power on switch/indicator limitations	IAT	ID	X		
No number	Use of solid state switch or relay	IA	I	X		
No number	Master power switch	IAT	ID	X		
3.2.4.2	Remote electronic chassis	IAT	I	X		
3.2.4.2(a) thru (e)	Remote electronic chassis	IA	I	X		
3.2.4.3(a) thru (d)	Remote control panel					Lower level requirements apply
3.2.4.4	Control subsystem					Lower level requirements apply
3.2.4.4.1	Mode change interface	IA	I	X		
3.2.4.4.1(a) thru (f)	Switch/indicators	IAT	ID	X		4.4.7.1
3.2.4.4.1.1	Color	IAT	ID	X		4.4.7.1
3.2.4.4.1.2	Dimming	IAT	ID	X		4.4.7.1
3.2.4.4.1.3	Lamp test	IAT	ID	X		4.4.7.1
3.2.4.4.1.4	Runway identification	IAT	ID	X		4.4.7.1
3.2.4.4.2 thru 3.2.4.4.2.8	Control algorithms	IAT	ID	X		4.4.7.1
3.2.4.4.2.9	Transients	IAT		X		4.4.3.4, 4.3.3,

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU PRO	TEST LOC FAC FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.2.4.4.3 thru 3.2.4.4.3.3	Data transmission	IAT IT	X	4.4.7.2, 4.4.12
3.2.4.4.3.4	Lightning protectors	IAT I	X	3.6.6, 4.4.3.4
3.2.4.4.4	Interfaces	IAT IT	X	4.4.7.1, 4.4.7.2
3.2.4.4.4.1	Switch/indicators			
3.2.4.4.4.2	TCCC interface	IAT ID	X	
3.2.4.4.5	Power instrumentation			Lower level requirements apply
3.2.4.4.5.1	Input power metering	IA I	X	4.4.13,
3.2.4.4.5.2	Input voltage metering	IAT ID	X	4.4.13,
3.2.4.4.5.3	Output voltage metering	IAT ID	X	4.4.13,
3.2.4.4.6	Power requirements	IA I	X	
3.2.4.4.7	Elapsed time indicators	IAT I	X	
3.2.4.5	Operational monitor subsystem	IAT ID	X	4.4.8.1
3.2.4.5.1	Monitor Performance			4.4.8.1, 4.4.11
3.2.4.5.2	Caution and failure conditions	IAT ID	X	4.4.8.1
3.2.4.5.3	Caution and failure selection range	IAT ID	X	4.4.8.1
3.2.4.5.4	Failed lamp simulation	IAT ID	X	4.4.8.1
3.2.4.5.5 thru 3.2.4.5.5.4	Operational monitor interface	IAT ID	X	4.4.8.1

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.2.4.5.6	Calibration	IAD	ID	X	X	4.4.8.2, 4.4.11
3.2.4.5.7	Non-volatile status	IAT	ID	X		4.4.8.1
3.2.4.5.8	Diagnostic program	IA	I	X		
3.2.4.5.9	Monitored parameter data	IAT	ID	X		
3.2.4.5.9	Outputs to remote monitoring subsystem (RMS)	IA		X		
3.2.4.5.10	Data archiving	IAD	ID	X		
3.2.4.5.11	Lightning protection	IA		X		
3.2.5	Flashing lights subsystem	IAT	ID	X		
3.2.5.1	Flasher master controller unit	IAT	ID	X		
3.2.5.1.1	Intensity control resistor cabinet	IAT	I	X		
3.2.5.1.2	Power	IAT	I	X		
3.2.5.1.3	Control	IAT	IT	X		
3.2.5.1.4	Master controller timing requirements	IAT	T	X		
3.2.5.1.5	Monitoring functions					Lower level test requirements apply
3.2.5.1.5(a)	Local/remote	IA	I	X		
3.2.5.1.5(b)	ALSF-2/SSALR	IA	I	X		
3.2.5.1.5(c)	Intensity	IA	I	X		
3.2.5.1.5(d)	On/off	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.2.5.1.5(e)	Caution	IA	I	X		
3.2.5.1.5(f)	Fault	IA	I	X		
3.2.5.1.5(g)	Individual	IA	I	X		
3.2.5.1.5(h)	Necessary switches and Indicators	IAT	ID	X		
3.2.5.1.5(i)	Reset	IAT	ID	X		
3.2.5.1.6	Local control panel monitor capability	IAT	ID	X		
3.2.5.1.7	Remote panel monitoring capability	IAT	ID	X		
3.2.5.1.8	Lightning protection	IA	I	X		3.6.6, 4.4.3.4
3.2.5.1.9	Elapsed time indicator	IA	ID	X		4.4.13
3.2.5.2	Flasher assemblies general requirements	IA	I	X		
3.2.5.2.1	Individual control cabinet	IAT	ID	X		
3.2.5.2.1.1	Input power	IAT	ID	X		
3.2.5.2.1.2	Input switch and fuse	IA	I	X		
3.2.5.2.1.3	Power and control circuitry	IA	I	X		
3.2.5.2.1.4	Lightning protection	IA	I	X		3.6.6, 4.4.3.4
3.2.5.2.2	Photometric performance	IAT	IT	X		4.4.9.1
3.2.5.3	Elevated flasher assembly (Type I)					Lower level test requirements apply
3.2.5.3.1	Flasher light unit	IAT	IT	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.2.5.3.1.1	Intensities of the elevated flasher	AT		X		
3.2.5.3.1.2	Flash tube	IA	I	X		
3.2.5.3.1.3	Window	IA	I	X		
3.2.5.3.1.4	Reflector	AT	I	X		
3.2.5.3.1.5	Socket	IA	I	X		
3.2.5.3.1.6	Mounting attachments	IA	I	X		
3.2.5.3.1.7	Flasher assembly wire	IA	I	X		
3.2.5.3.1.8	Flasher light unit weight	IAT	I	X		
3.2.5.3.1.9	Aiming device for the flasher light unit	IAT	IT	X		4.4.9.9
3.2.5.4	Semiflush flasher assembly (Type II)					Lower level test requirements apply
3.2.5.4.1	Semiflush light unit	IA	I	X		
3.2.5.4.1.1	Semiflush light unit top assembly	IAT	IT	X		4.4.9.8
3.2.5.4.2	Intensity of the semi-flush light unit	AT		X		
3.2.5.4.3	Static loading	AT		X		4.4.9.2
3.2.5.4.4	Window loading	AT		X		4.4.9.4
3.2.5.5	Flasher tester	IAT	IT	X		4.4.10
3.2.5.5.1	Physical characteristics					
3.2.5.5.2	Electrical measurements					
3.2.5.5.3	Operation					

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.2.5.5.4	Tester instructions					
3.2.5.5.4.1	Portable instructions					
3.2.5.5.4.2	Flasher tester instruction book					
3.2.6	Elevated PAR-56 lamp-holders	IA	I	X		
3.2.6.1	Aiming device for the PAR-56 lampholder	IAT	IT	X		4.4.9.9, 3.2.5.3.1.9
3.2.7	Site spare parts					Covered under other test requirements
3.2.8 thru 3.2.8.7	Equipment required but not furnished					No test requirements
3.2.9	Remote monitoring subsystem (RMS)					Subparagraph requirements apply
3.2.9(a)	Lightning protection	IA	I	X		
3.2.9(b)	Sensors	IA	I	X		
3.2.9(c)	VME card cage	IAT	ID	X		
3.2.9(d)	Interfaces	IA	I	X		
3.2.9(e)	Capability	IAD	ID	X		
3.2.9(f)	Initialization/self-testing capability	IA	I	X		
3.2.9.1	General RMS requirements	IA	I	X		
3.2.9.1.1	MDT interface	IAD	ID	X		
3.2.9.1.2	MPS interface	IAD	ID	X		
3.2.9.1.2.1	Protocol					

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC	CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC FLD	REMARKS
3.2.9.1.3	VME bus interface system	IAD	ID	X	
3.2.9.1.4	Memory	IA	I	X	
3.2.9.1.4.1	Volatility	IAD	ID	X	
3.2.9.1.5	RMS expansion	IAT	ID	X	
3.2.9.1.6	Test points	IAD	I	X	
3.2.9.1.7	Indicator lights	IAD	ID	X	
3.2.9.1.8	Reset switch	IAD	ID	X	
3.2.9.1.9	Environmental sensors	IAD	ID	X	
3.2.9.1.10	Data communications failures	IAD	ID	X	
3.2.10	RMS performance parameter monitoring requirements	IAD	ID	X	
3.2.10.1	System status parameters	IAT	ID	X	
3.2.10.1.1	Sensors				
3.2.10.2	Key equipment performance parameters	IAT	ID	X	
3.2.10.3	ALSF-2/SSALR certification parameters	IAT	ID	X	
3.2.10.4	Performance checks	IAT	ID	X	
3.2.10.5	Environmental parameters				Subparagraph requirements apply
3.2.10.5.1	Intrusion detector	IAD	ID	X	
3.2.10.5.2	Smoke detector	IAD	ID	X	

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	REMARKS
3.2.10.5.3	Commercial ac power	IAT	IT	X		
3.2.10.5.4.	Engine generator ac power	IAT	ID	X		
3.2.10.5.5	Inside temperature	IAT	ID	X		
3.2.10.5.6	Outside temperature	IAT	ID	X		
3.3 thru 3.3.10	Physical characteristics	IA	I	X		
3.4	System requirements					Lower level requirements apply
3.4.1	Power quality requirements	IA	ID	X		
3.4.2 and 3.4.2.1	Modular construction	IA	I	X		
3.4.3	Interchangeability	IA	I	X		
3.4.4 and	Test points and controls	IA	I	X		
3.4.4.1	Remote maintenance monitoring test points					
3.4.4.1.1 thru 3.4.4.1.4	Test connectors	IAT	IT	X		
3.4.5(a) thru 3.4.5(c)	DC power supplies	IAT	IT	X		
3.4.6	Extender boards	IA	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.4.7	Derating of electronic parts	A		X		
3.4.8 thru 3.4.8.5	Enclosures	IA	I	X		
3.4.9	Earth grounding	IAT	ID	X		
3.4.10	Nameplates	IA	I	X		
3.4.11	Assembly and marking	IA	I	X		
3.4.12	Warning signs	IA	I	X		
3.4.13	High voltage insulation	IAT	IT	X		4.4.4
3.4.14	Software/firmware requirements	IA		X		
3.4.14.1	Operating system (OS) requirements	IA	ID	X		Subparagraph requirements apply
3.4.14.2	Defensive coding	IAD	ID	X		
3.4.14.3	Operating parameters	IAD	ID	X		
3.4.14.3.1	Initialization/restart	IAD	D	X		
3.4.14.3.2	Switch action	IAD	D	X		
3.4.14.4 and 3.4.14.4(a) thru (g)	Software utility services	IA	I	X		
3.4.14.5 thru 3.4.14.5(c)8	System error messages	IAD	ID	X		
No number	Sentence below 3.4.14.5(c)8	IAD	ID	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS PARAGRAPH	TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S) OR REMARKS
3.4.14.6	System growth capabilities					Subparagraph requirements apply
3.4.14.6(a) thru (c)	System growth	IAD	ID	X		
3.4.15	RMS functional requirements					Subparagraph requirements apply
3.4.15.1	Monitoring requirements	IAD	ID	X		
3.4.15.2	Alarm limits	AD	D	X		
3.4.15.3	Control command requirements	AD	D	X		
3.4.15.3.1 and 3.4.15.3.1(a) thru (h)	MPS interface commands	AD	D	X		
3.4.15.3.2 and 3.4.15.3.2.1 thru 3.4.15.3.2.14	MDT interface commands	AD	D	X		
3.4.15.4 and 3.4.15.4(a) thru (c)	Diagnostics requirements	AD	D	X		
3.4.15.4.1	Fault isolation	AD	D	X		
3.4.15.5	Physical security requirements	AD	D	X		
3.4.15.6	MDT process security requirements	AD	D	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII

ALSF-2/SSALR VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD		TEST LOC		CROSS REFERENCE PARAGRAPH(S) OR REMARKS
PARAGRAPH	TITLE	DQU	PRO	FAC	FLD	
3.4.15.6.1	Authority	AD	D	X		
3.4.15.7	RMS performance requirements	AD	D	X		
3.4.15.7.1	Monitoring requirements	AD	D	X		
3.4.15.7.2	System integrity	IAD	ID	X		
3.4.15.7.3	RMS sampling frequency	IAT	ID	X		
3.4.15.7.4	Alert and alarm determination	IAT	ID	X		
3.4.15.7.5	Change of state determination	IAT	ID	X		
3.4.15.7.6	Performance parameter request	IAT	ID	X		
3.4.15.7.7	Command execution	IAT	ID	X		
3.4.15.7.8	Communications requirements	IAT	ID	X		
3.4.15.8	System initialization requirements	IAD	ID	X		
3.4.15.8.1	Startup	IAD	ID	X		
3.4.15.9	MDT communications	IAD	ID	X		
3.5 and 3.5.1	Parts					Lower level test requirements apply
3.5.1.1	AC power connections	IA		X		
3.5.1.2	Discrete components	IA		X		
3.5.1.2.1	Flasher assembly capacitors	IA		X		
3.5.1.3	Fuses	IA	I	X		

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR-VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

PARAGRAPH	REQUIREMENTS TITLE	TEST LEVEL AND METHOD DQU	PRO	TEST LOC FAC	FLD	CROSS REFERENCE PARAGRAPH(S)
3.5.1.4 and 3.5.1.5	Devices	IA	I	X		
3.5.1.6	Fastener hardware	IA	I	X		
3.5.1.7	Interlock switches	IAT	IT	X		
3.5.1.8	Terminal blocks	IA	I	X		
3.5.1.9	Other parts	IA	I	X		
3.5.2 thru 3.5.7.9	Materials	IA	I	X		
3.6	Environmental requirements					Lower level requirements apply

Note 1: When the equipment design has previously passed design qualification testing to the envirnmental and other requirements herein, redundant design qualification testing need not be accomplished. In such cases, mandatory testing as designated by a "T" shall be replaced by an "A" indicating a requirement for analysis of previous design qualification test data. Paragraphs 3.6.1 thru 3.6.7. are candidates for such a change.

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR-VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD	TEST LOC	CROSS REFERENCE PARAGRAPH(S)
PARAGRAPH	TITLE	DQU PRO	FAC FLD	
3.6.1	Indoor equipment	T	X	3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5.1, 3.2.7
3.6.2.1	Temperature	T	X	4.4.3.1, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7
3.6.2.2	Altitude	T	X	4.4.3.3, 3.2.1, 3.2.2., 3.2.3, 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7
3.6.2.3	Humidity	T	X	4.4.3.2, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7
3.6.2.4	Sand and dust	T	X	4.4.3.8, 3.2.5.3, 3.2.5.4
3.6.2.5	Salt fog	T	X	4.4.3.6, 3.2.5.3, 3.2.5.4, 3.2.5.3.1.9, 3.2.5.5
3.6.2.6	Rain	T	X	4.4.3.5, 3.2.5.3, 3.2.5.4, 3.2.5.3.1.9, 3.2.5.5
3.6.2.7	Solar radiation (sunshine)	T	X	4.4.3.9, 3.2.5.3, 3.2.5.4
3.6.2.8	Temperature shock	T	X	4.4.3.1, 4.4.9.5, 3.2.5.3, 3.2.5.4
3.6.2.9	Vibration	T	X	4.4.9.6, 3.2.5.3, 3.2.5.4
3.6.3	Impact	T	X	4.4.9.3, 3.3.5.4
3.6.4	Hydraulic impact	T	X	4.4.9.4, 3.3.5.4
3.6.5	Snowplow impact	T	X	4.4.9.7, 3.3.5.4

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR-VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

REQUIREMENTS		TEST LEVEL AND METHOD	TEST LOC	CROSS REFERENCE PARAGRAPH(S)
PARAGRAPH	TITLE	DQU PRO	FAC FLD	
3.6.6	Transient suppression	T	X	4.4.3.4, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4, 3.2.7
3.6.7	Interference requirements	T	X	4.4.3.7, 3.2.3, 3.2.4, 3.2.5.1, 3.2.5.3, 3.2.5.4
3.7 thru 3.7.2	Instruction book			Other test requirements apply
3.8	Reliability			Lower level test requirements apply
3.8.1(a) and 3.8.1(b)	Reliability design criteria			No test requirements
3.8.1(c), 3.8.1(d), and 3.8.1(e)	Reliability design criteria	A	X	
3.8.2 thru 3.8.2.4	Reliability program			Other test requirements apply
3.9	Maintainability			Lower level test requirements apply
3.9.1(a) and 3.9.1(b)	Maintainability design criteria			No test requirements
3.9.1.(c), 3.9.1(d), and	Maintainability criteria	A	X	

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

TABLE XVIII
ALSF-2/SSALR-VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

PARAGRAPH	REQUIREMENTS TITLE	TEST LEVEL AND METHOD DQU PRO	TEST LOC FAC FLD	CROSS REFERENCE PARAGRAPH(S)
3.9.1(e)				
3.9.2 thru 3.9.2.3.2	Maintainability program			Other test requirements apply
3.10	Configuration management			No test requirements

Note 2: Overall visual inspection requirements per Paragraph 4.4.1 are contained in Table XVI.

Note 3: Overall system Twenty four-hour test requirements per Paragraph 4.4.2 are contained in Table XVI.

Note 4: Overall system 150 hour test requirements per Paragraph 4.4.5 are contained in Table XVI.

Note 5: All test measurements shall be made using calibrated test instruments per Paragraph 4.5.

VERIFICATION METHODS: INSPECTION-I, ANALYSIS-A, TEST-T, DEMONSTRATION-D
TEST LEVEL AND METHOD: DESIGN QUALIFICATION-DQU, PRODUCTION-PRO
TEST LOCATION: FACTORY-FAC, FIELD-FLD

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS